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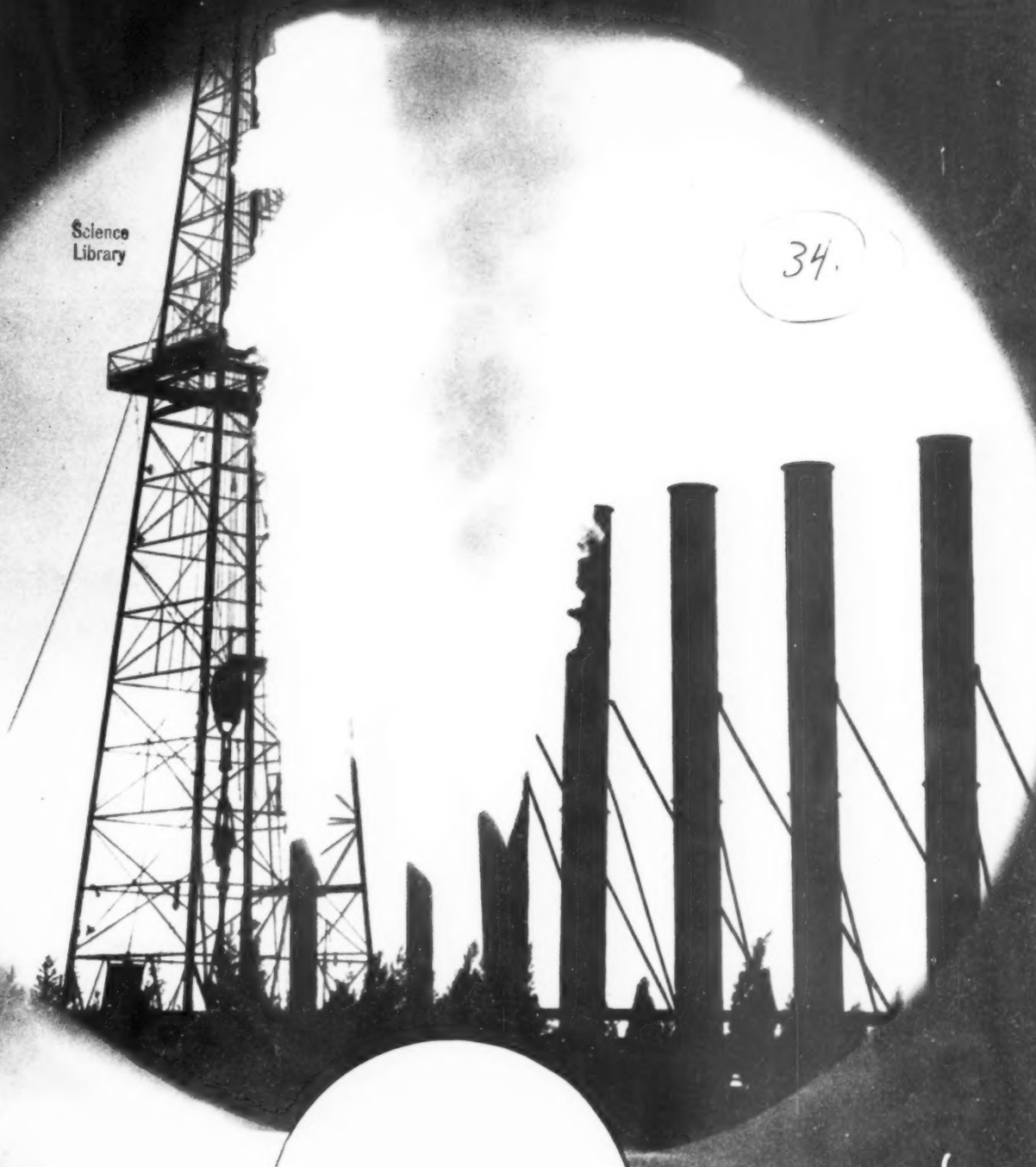

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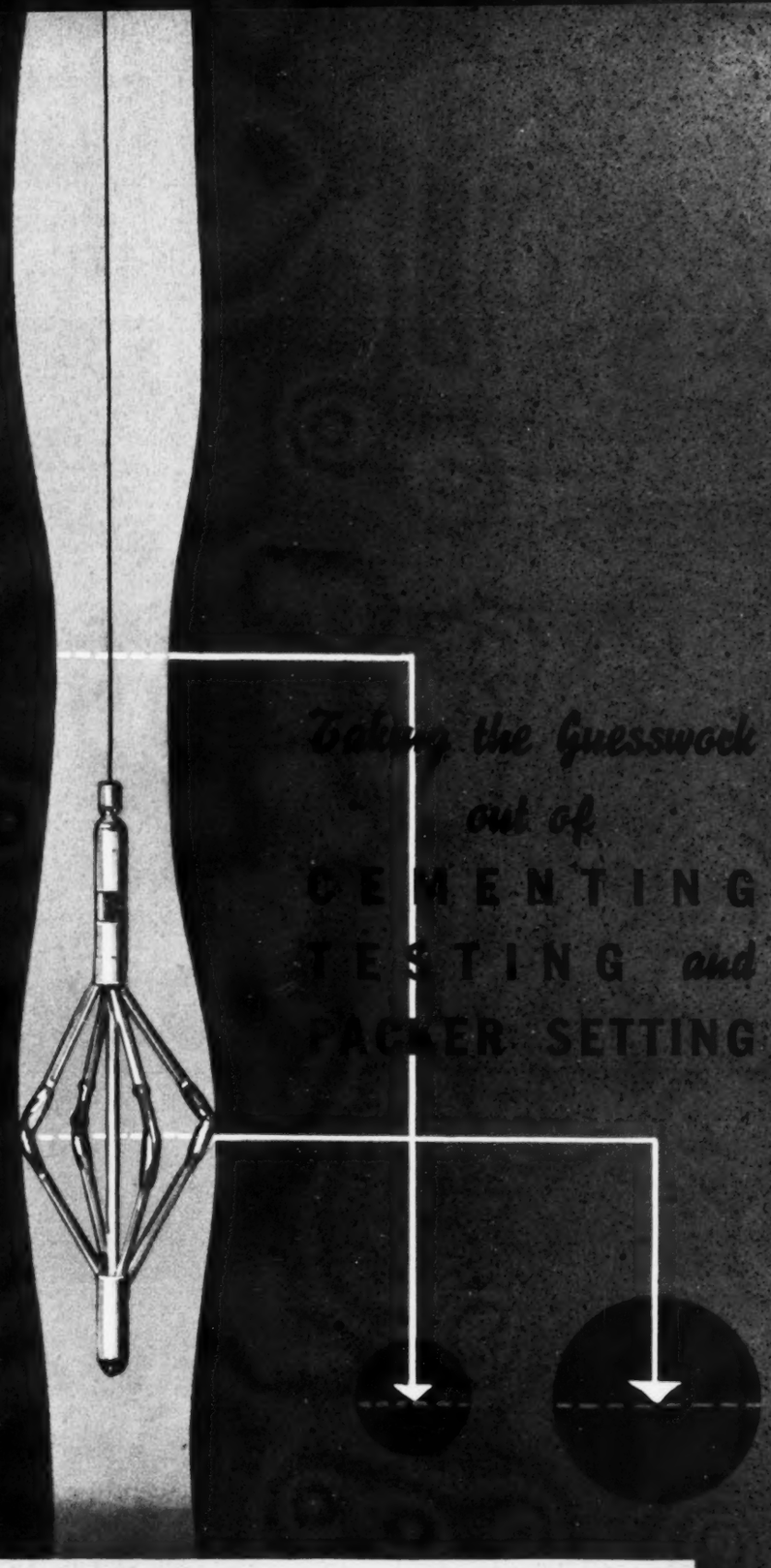

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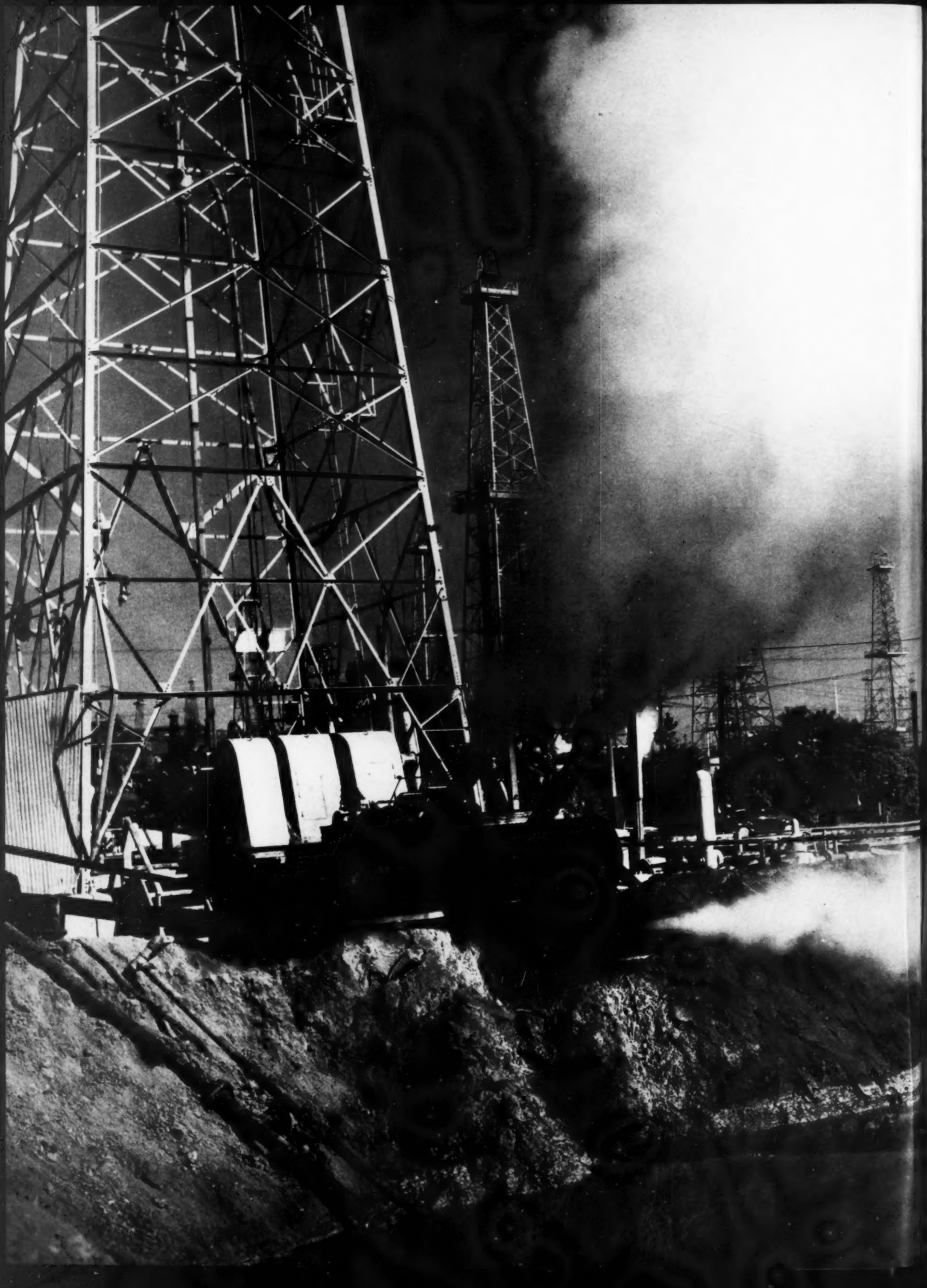

EDITORIAL

FUTILITY OF FIGHT AGAINST PIPE LINES

ACTION by southeastern railways, backed by the state legislature of Georgia, in delaying temporarily the building across the state of pipelines for the transportation of petroleum products has raised a double issue. One phase of this issue relates to the right of a state to prevent action deemed necessary to national defense. The other aspect is the economic folly of attempting to prevent the introduction of a cheap and efficient method of conducting business in order to maintain an archaic and expensive system.

On the first part of this question there can be no difference of opinion once the facts are established. National safety, the ability to defend the country which now has come to mean the extension of a full measure of support to the nations struggling against totalitarianism, can brook no interference from states or individuals. Appreciating this fact the spokesmen for the railways uphold their opposition to the building of pipelines by the claim that the lines are of no importance in strengthening the defense position of the nation, that they were projected and will be used if built primarily to serve the needs of the civilian population, and that the railways themselves are perfectly able to transport all the petroleum products needed to meet both civilian and military requirements in the areas they serve.

This attitude disregards the primary factor in the strategic phase of the situation. It is not a question of pipeline versus tank car transportation. The products which would move through the pipelines over which the controversy has arisen are not now being conveyed by the railways and cannot be so handled except by increasing their cost beyond the levels at which they now are selling, an unnecessary burden on consumers. Sixty-five percent of the traffic in petroleum products in the area concerned is handled by water carriers. The value of the proposed pipelines from the viewpoint of national security lies in avoiding the risks that might attach to the water route in case the war crosses the Atlantic, but mainly in reducing to some extent the number of tankers required to maintain the flow of products from the Gulf Coast around the Florida penninsula to the Atlantic Seaboard.

This is a phase of the situation that has assumed much greater gravity even in the few weeks since discussion of the pipeline issue began before a commttee of Congress. How seriously it is regarded in informed quarters is indicated by the large tanker order recently placed by the Maritime Commission in addition to the extremely heavy tonnage already on the ways. Shipping is recognized as the decisive factor in the war, and the losses being incurred make it imperative not only to build at top speed but to conserve in every way possible the tonnage now in service. Against this vital necessity how puny appears the possibility that a few railway lines may lose an inconsequential fraction of their freight business at a time when the total volume of their traffic is increasing steadily and is bound to grow still more as the armament effort attains momentum?

This problem of transportation was foreseen and pointed out months ago, long before it had assumed its present acute form. It was stated in a report of the National Defense Advisory Council submitted September 14, 1940 in the following terms:

"At present both the Army and the Navy are interested in having private capital construct pipelines to transport gasoline to the east coast states without the necessity of the long haul around Florida and up the Atlantic coast, which in time of emergency might be difficult and in any event would require a large convoy service.

"Moreover, in time of emergency it would be possible to take a part of the burden of the gasoline deliveries to the east coast through these gasoline pipelines and in turn release tankers for the purpose of handling the essential products such as navy fuel oil which cannot be handled in crude oil or gasoline pipelines.

"These gasoline pipelines would also afford exceptionally desirable locations for some of the reserve stocks of aviation gasoline for both the Army and Navy since deliveries can be made at low cost and removal can be effected readily even in time of emergency.

"An initial expenditure of approximately $13,000,000 [the actual sum is more] is involved in the gasoline pipelines now under consideration and it would be desirable to have private capital construct similar equipment for emergency use in other parts of the country.

"The Army plans to locate most of its interior reserve storage at points on gasoline pipelines. Such location of large buried storage facilities would not only be virtually invulnerable but would make it possible to deliver the gasoline to the Army through any of the industry tap points or bulk plants located along the gasoline line or lines to which the Army storage would be connected.

"In addition, the Navy is giving consideration to the location of some of its reserve storage adjacent to or connected with petroleum products pipelines at existing industry terminals. This would greatly reduce the investment in docks, lines, utilizing facilities and so forth and also minimize the labor required to guard and operate these facilities.

"It is clear that substantial additions to the gasoline pipeline and terminal storage capacity of the industry will be necessary under this program".

←Front cover and frontispiece are scenes from California taken by Cy La Tour.

Many sections of the country are well served by gasoline pipelines. Their mileage has grown very rapidly in the past few years. New lines to serve the midwestern and north central states are now under construction or shortly to begin. The one important section east of the Mississippi that is entirely lacking in such facilities is the southeastern group of states. It so happens that this is the very area where pipeline service is most needed because of the naval bases and army posts that have been located within its boundaries. This should dispose of any argument as to the national need for the building of these lines with all speed, a service that will cost the government and the taxpayers nothing because the expense will be borne by the oil companies themselves.

Even though no questions of national necessity were involved the action of the railways and its support by a state legislature is both silly and futile. It is of a piece with the attempt of hand spinners to prevent the introduction of the Arkwright loom, of stage coach and canal boat opposition to the building of railways and of all the antagonism against the adoption of labor saving and cost reducing methods and appliances. It is silly because those who oppose the march of progress actually stand to gain by it and would suffer if their efforts were successful. It is futile because in a competitive system those who persist in fighting against improved methods are certain to be defeated by the inexorable operation of economic law.

This truth was well stated by Chairman Joseph R. Eastman of the Interstate Commerce Commission, the body which is the official guardian of the railways, before a Congressional committee in Washington:

"When it comes to the protection of one form of transportation against another," said Mr. Eastman, "it has been my personal view that the construction of new facilities ought not to be prevented on the ground that they will injure existing facilities, where it can be shown that the new proposed facilities are a distinct improvement over those which exist. In other words, if they can perform the service better and cheaper than existing facilities, the public ought not to be deprived of those benefits merely because it may result in some detriment to existing transportation facilities".

While admitting that transportation of petroleum by pipeline was more economical than its movement by rail, the railway officials opposing the pipelines declared that this was of no advantage to the public because the saving was not passed along to consumers. This assertion was fully and effectively answered by Mr. Haslam in a statement filed with the Cole committee on April 1st. This document showed by a detailed comparison of actual prices that in districts where petroleum products were delivered by pipeline average prices to consumers were lower than in areas depending upon rail transportation. No proof of this fact was needed by oil men who are engaged in the daily battle for sales, but it supplies a convincing answer to a fallacious claim.

Because of the close competition that prevails in the oil industry it has long been recognized by progressive men in the business that low cost transportation is essential to the maintenance of a strong competitive position. That was the reason for the building of the first pipeline. It was responsible for the first gasoline pipeline and for the rapid spread of the system in the past ten years. The most successful petroleum marketing companies in the country are those which have carried to the greatest extent the movement of crude and products by the safe, cheap and efficient system of pipeline transportation. Despite all the opposition that short-sighted railway officials and backward-looking legislatures can muster, the movement of petroleum products by pipeline is destined to grow and grow until it covers the country in a network as universal as those of the telegraph and telephone.

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Central Mexico City from the air.

Manuel Avila Comacho, president of Mexico.

MEXICO

WRESTLING WITH ACUTE FINANCIAL PROBLEM OF OIL

Industry Which Was One of Chief Contributors to Federal Revenue Under Private Ownership Has Built Up Increasing Deficits Since Government Took Over.

DESPITE a steadily mounting deficit which most strenuous efforts of the government have been unable to overcome the nationalized Mexican oil industry enters the fourth year following confiscation "full of optimism and enthusiasm." This at least was the statement of Elfrain Buenrostro, managing director of Petroleos Mexicanos, in one of the speeches that marked the celebration of the third anniversary of the seizure of properties of the principal oil companies formerly operating in Mexico.

This optimism is scarcely shared by officials of the Treasury department who see oil transformed from one of the chief sources of federal revenue to a financial drain that becomes ever more heavy and aggravates the economic plight of the nation.

In a report prefacing an announcement of the program of Petroleos Mexicanos for 1941 Sr. Buenrostro referred to "unpatriotic obstructions" and "attitudes of misunderstanding" that had hampered the operations of the industry under government control but did not elaborate on these phases. Inability to make a better showing during the past year, particularly the falling off in exports, he attributed mainly to the war with its shutting off of markets, the withdrawal of tankers and the increasing difficulty of obtaining materials indispensable to the conduct of the industry. He gave some figures of income and expenditure and these, while not sufficiently complete to supply a full picture of the situation, indicated that the business had lost further ground in 1940 as compared with the two previous years under government direction.

Production of crude in 1940 was stated as 41,876,000 bbl., or an average of 114,729 bbl. daily. This compares with an output of 46,690,000 bbl. in 1937 the last year of private operation. Private sources have estimated Mexican crude production at a slightly higher figure as follows: Poza Rica, 28,400,000 bbl; North Zone, 6,200,000 bbl.; Isthmus of Tehuantepec, 5,600,000 bbl; and the South Zone, 3,800,000 bbl. It is asserted, however, that potential production is 240,000 bbl. daily as compared with 140,000 bbl., in the earlier period and it is claimed that the lower rate of actual production is due to lack of markets for the oil. Runs

Above, Lombardo Toledano, Mexican labor leader.

Right, Efrain Buenrostro, managing director of Petroleos Mexicanos.

to stills last years are given as 29,803,000 bbl., an average of 81,650 bbl. daily for the refineries at Ciudad Madero, Arbol Grande, Mata Redonda, Minatitlan, Atzcapotzalco and Bellavista, and the primary distillation plant at Poza Rica.

Refinery throughput was roundly 2,000,000 bbl., less in 1940 than in the year preceding. This, it is explained, was due in part to lack of markets and in part to the necessity of suspending operations in some plants to make repairs urgently needed since 1937.

Domestic sales are reported as amounting to approximately 195,500,000 pesos (roughly $40,000,000) in 1940 as compared with 176,500,000 pesos in 1939 and 158,500,000 in 1938. Part of this increase in sales was due to the influx of motorists from the United States. To meet complaints from this quarter as to the poor quality of gasoline offered, a new quality fuel, Mexolina 70, was introduced. Efforts were made also to increase the use of kerosene and fuel oil among the poorer elements of the population by selling oil stoves, heaters and lamps at cost.

Export sales last year were said to amount to about $16,000,000. In 1939 the chief export markets were Germany and Italy, with which countries Mexico made barter agreements. Since shipments to these countries were stopped by the outbreak of war the greater part of Mexico's exports have gone to the United States. The report calls attention to the fact that ever since the government took over the oil properties exports have been hampered by the lack of tankers. This was relieved to some extent by the purchase for $1,600,000 of the four vessels "Tampico", "Cerro Azul", "Juan Casino" and "Cuauhtemoc" which are now in service. Contracts were made with Italy for three 10,000-ton tankers to cost $3,700,000, payable in oil. Although these ships have been paid for, delivery has been prevented by the war.

School house for Mexican children built by the oil companies at Poza Rica before expropriation.

Airview of the former Shell refinery, Minatitlan, 22 miles up the Uspanapa River from the Gulf of Mexico.

Mexicana Aerofoto S. A.

Oil exports from Mexico last year are figured by private sources about as follows:

Destinations	Total	Barrels Refined	Crude
United States	15,700,000	4,150,000	11,550,000
Italy	2,950,000	700,000	2,250,000
Japan	760,000	.....	760,000
Bunker	550,000	550,000	.....
Cuba	130,000	130,000	.....
Scandinavia	100,000	100,000	.....
Australia	90,000	90,000	.....
Chile	80,000	80,000	.....
Portugal	80,000	80,000	.....
Uruguay	70,000	70,000	.....
Miscellaneous	40,000	40,000	.....
	20,550,000	5,990,000	14,560,000

Very little has been done in the way of drilling. Last year, it is stated, 23 wells were put down of which 17 were producers adding 72,000 bbl. per day to production capacity. As has been pointed out by practical oil men drilling at this rate is wholly inadequate to sustain production for any considerable length of time. In recognition of this fact the program of Petroleos Mexicanos calls for greater expenditure on geophysical exploration and wildcat drilling during the coming year.

Extensive plans for refinery improvement, announced last year, have been carried through only in part. Reconditioning of four towers at the Ciudad Madero refinery to increase capacity from 35,000 to 70,000 bbl. daily is said to be completed to the extent of 60 percent on two of the towers and 25 percent on the others. Part of the material and equipment for doubling the capacity of the Arbol Grande plant from 6,500 to 13,000 bbl. daily has been acquired. Installation of a Clark processing unit is reported to be nearly completed and three new boilers and a tubular still are being added to the Minatitlan refinery in Vera Cruz.

After voiding the patents of the Ethyl Corporation, a plant for the production of tetraethyl lead was built in 1940 but it was destroyed by fire in August, shortly after completion. Supplies for the repair of the plant are said to have been ordered from the United States but have not yet been delivered. It is admitted that in the present state of Mexico's refineries no substantial increase in throughput is possible, but it is claimed that this condition will be remedied within the year. Under private operation the bulk of Mexican exports were in the form of finished products, but since the government took over most of the shipments have consisted of crude.

While the economic condition of the industry is admittedly not flourishing, the report declares that the business is in no danger of collapsing. "The aid of the entire nation," it says, "and of the federal government as well as the cooperation of all elements necessary have made possible the surmounting of innumerable obstacles and assure the future life of this important source of economic activity." Details of financial operations contained in the report are sketchy, but the drastic moves which the government has found neccessary make it appear that the heavy deficits of 1938 and 1939 have been continued or possibly increased during the past year.

The industry's revenues in 1939 are stated to have been about 32,000,000 pesos after deducting sums set aside to indemnify the owners of the properties, refining costs at Houston, Texas, and export taxes. But in the first half of 1940, this net income had dwindled to less than 2,500,000 pesos and Petroleos Mexicanos estimates that its net revenues for the year will not exceed 6,500,000 pesos. Payrolls and economic benefits for workers jumped from around 48,545,000 pesos in the first half of 1939 to about 51,000,000 pesos in the first semester of 1940 and capital investments increased from less than 22,000,000 pesos in all 1939 to about 28,500,000 pesos in the first half of last year alone. Losses in 1939 were variously reported from 22,000,000 to 80,000,000 pesos depending on the method of computation. High reliable private sources have estimated that the deficit on this government operation from expropriation through 1940 amounts to approximately 150,000,000 pesos.

Ex-President Lazaro Cardenas' reorganization program for the oil industry, put forward early in 1940, was intended to save the business from bankruptcy, the report says. This plan called for the elimination of superfluous personnel and abolishing costs that were not indispensable. The plan caused much friction between the union and the oil company and provoked an economic crisis last July when the workers appealed to the labor authorities to protect their monetary rights. This quarrel was smoothed over by the federal board of conciliation and arbitration ordering the provisional reduction by 10 percent of all monthly wages of more than 700 pesos, suspensions of payments from the workers saving fund, payments of house rents for workers whose daily pay exceeded ten pesos, vacations, and substitutes to fill temporary vacancies and the cutting of overtime pay.

These measures immediately had beneficial results as they enabled the company to meet little by little certain obligations, such as the payment of the gasoline consumption tax pledged as service on the federal road bonds. It also enabled the company to cover back debts for freight rates and raw materials, amounting in all to more than 2,000,000 pesos, and to spend 3,000,000 pesos for equipment urgently needed to improve refineries.

The board, however, lifted its suspensions and reductions order last November 28. The company immediately paid savings fund benefits of more than 11,500,000 pesos, renewed the payment of house rents and resumed vacation privileges that corresponded to 1940. But in order to meet these demands it was necessary for the company to obtain a large but unspecified loan, repayable from its 1941 income.

The federal government lent the industry a

further helping hand by suspending the collection of taxes and providing funds of an unpublished amount to enable the company to pay pressing debts. Last September, the company was exempted from the 12 percent federal tax on exports and President Cardenas asked Congress to modify the oil production tax law, starting January 1, thereby greatly reducing the oil company's expenditures. On December 31, the federal government requested Congress to approve a grant of 60,000,000 pesos to the company to cover its capital investments.

A budget of 199,564,000 pesos has been assigned for 1941 operating and maintenance costs. This budget is based upon expected revenues from home and export sales, and not only includes normal costs of various phases of the organization, production, refining, home and foreign sales, general offices and other services, but expenses for exploration which for the first time since expropriation are to be intensified. This plan calls for a 7,000,000 peso investment in 1941, an outlay that the company hopes to increase in the future. This year these works contemplate the completion of four explorations in the northern zone and two in the southern zone and geological and geophysical surveys in both zones. Explorations are to be made along the Pacific coast "which up to now has shown scant prospects of important oil deposits, but which," it is stated, "must not be rejected until a thorough investigation of its structures and possibilities has been made."

Proposed exploratory drillings this year are three each in the northern and southern zones, and two in the northeast zone, as well as the completion of one in that region which was suspended. Thirty-eight exploitation drillings will be made in 1941: 15 in the northern zone, 23 in the southern.

Refining in 1941 will be held to the manufacture of products necessary for home and export demand. Measures will be adopted to assure efficient distribution in the domestic market. Distribution of "Mexolina 70" is to be extended to all paved roads in Mexico, and the octanage of this gasoline will be increased from 70 to 72, as a minimum. More service stations will be opened, including in some cases, restaurants and lodging facilities. Four of these stations will open this spring.

Equipment for extending the distribution of Pemex gas is to be acquired, as domestic demand is increasing. Advertising of this gas is to be intensified but its price will be reduced.

Petroleos Mexicanos is to further its cooperation in the national campaign to attract tourists by maintaining its cash contribution to agencies for this service, publishing propaganda literature and road maps and supporting a special department which proportions an annual average of 15,000 information services for foreign motorists. Special efforts are to be made to increases sales of oil specialties, such as waterproof substances, polishing wax, insecticides and solvents.

Great efforts are to be made toward obtaining more and better foreign markets for oil and its products. High hopes in this regard are held for Latin America. Social and medical services for workers are to be expanded and improved, and the economy program calls for reorganizing the administrative division, but not at the cost of its efficiency.

Capital investments planned for this year include completing an aqueduct and a pumping plant to supply the Ciudad Madero, Arbol Grande, Mata Redonda and Bellavista refineries with more water; deviate the Poza Rica-Atzcapotzalco pipeline at its entrance to Mexico City; install a submarine loader at Tuxpan to facilitate servicing tankers; construction of five tanks at Poza Rica, and general improvements to existing tanks and batteries, as well as the installation of gas separators and compressors and improving well pumping and exploitation systems. Fire protection services will be improved in all important fields and terminals, providing these services where they are lacking. Refineries will be reconstructed and amplified.

New refinery works this year include:

Amplifying the distillation plants, raising the capacity of the paraffine plant and providing more steam, water and reconditioning tanks at Ciudad Madero; completing installation of three boilers and renovating the high vacuum towers, plants and storage services at Minatitlan; completing installation of an ebullition tower, finishing 60 percent of a stabilization plant, amplifying the asphalt plant, expanding the water treatment plant, and providing large storage tanks at Atzcapotzalco; enlarging plant No. 3 and starting installation of a high vacuum lubricants plant, 15 to 20 percent of the latter plant to be completed this year, repairing the paraffine plant, installing boilers, and reconstructing the fire protection service and storage tanks at Arbol Grande; amplifying primary distillation plant No. 2, and making important repairs to primary plant No. 3, and the disintegration units at Mata Redonda; installing a small pilot polymerization plant to treat 280,000 cu. ft. daily of gas and obtaining polymerized gasoline of high octanage at Bellavista.

The refineries improvements program is counted upon to provide at least 165,000 bbl. daily at the start of 1942. That will be almost double the present daily production of the refineries, thereby placing Mexico in an excellent position to cater on a larger scale to the foreign trade with oil products. This is in accordance with the plans the government made before expropriation to give preference to exports of oil products. The company expects that this year commercial operations of its tetraethyl lead plant will be resumed. The output of this plant is expected to be normalized by May or June. Studies are being completed for commercialization of Poza Rica gas.

One tanker, the Los Angeles, was purchased from Union Oil Co. by Mexican Shipping and Trading Co., a U. S. corporation, all of whose stock is owned by Petroleos Mexicanos. It will start service early in May. No further tanker purchases are contemplated for the immediate future, as several Italian tankers seized by the Mexican government following U. S. precedent, will meet requirements in this respect when repaired and ready for service. Social service for workers will be advanced with the investment of 2,500,000 pesos. Items included are the establishment of a concentration hospital in Mexico City, 1,000,000 pesos; building model homes for workers, 1,000,000 pesos; and 500,000 pesos to provide water in work zones where this service is urgently necessary. The company is also to spend 500,000 pesos to improve its general headquarters building in Mexico City, which was the office headquarters of Mexican Eagle before expropriation. In all, capital investments this year will total 50,000,000 pesos. The federal government will help along this program with the contribution of 9,000,000 pesos, payment of three percent annual interest on the 300,000,000 pesos of capital it has in Petroleos Mexicanos. This investment will include the "foresight fund" of 30,000,000 pesos that has accumulated since expropriation, and is to be used now for the first time. The rest of the money for these investments will be forthcoming from various government sources. This aid, the report remarks, "demonstrates the interest of the President of the Republic in improving the oil industry."

Such is the program projected for the Mexican oil industry. How fully it will be carried out remains to be seen. If past experience is an accurate criterion performance will fall far short of plan, but full financial backing by the government some improvement in organization and in physical equipment seems probable. On the political front, however, the industry is far from being stabilized.

In accordance with the Cardenas reorganization plan, more than 3,000 employees have been dismissed, including, the management explains, new comers who were hired after expropriation and all who were not essential to the industry. The expropriated companies always got into trouble when they tried to reduce personnel, and even with government approval the wholesale dismissals have caused much friction between the oil workers union and Petroleos Mexicanos. Section No. 1 of the union (Tampico and Ciudad Madero), made up mainly of former Mexican Eagle employees, has frequently threatened to engineer a general strike unless the company backs down on its economy plan. This section has severed connections with the union's executive committee, explaining that it does not agree with the policy of seeking to make the workers conform to the dismissal program, and told Petroleos Mexicanos that it intends to deal with it directly in all matters concerning the company and the workers. Petroleos Mexicanos discounts the strike threats, declaring that the movement is being backed only by a small group of agitators.

Troops have been stationed at the Mata Redonda Terminal (Tampico) which was operated by the expropriated Huasteca Petroleum (Standard of New Jersey) to curb an unruly attitude the workers there have assumed because of the dismissals program and to prevent sabotage.

Petroleos Mexicanos vigorously denied the statement made by the national railroad workers union in an open letter to President Manuel Avila Camacho in connection with the functioning of the National Railways, control of which the new government recently took out of the workers' hands and put in its own charge.

that inferior fuel oil is a factor in the deficient service of the railways. The oil company called the railroaders' accusation "superficial and naive" and asserted that not only railroad fuel oil but all its oil and its products are being maintained at the standards that were in effect at the time of expropriation. The union retorted to this denial by declaring that much more fuel is now necessary to power the railways passenger and freight locomotives than was necessary in 1939, and that while the engines are not of the best, many of them being 40 and more years old, inferior oil makes necessary the use of more fuel.

Lic. Vicente Lombardo Toledano, long Mexico's labor czar, who expressed his approval of the oil property confiscation, was not a candidate for reelection to the post he formerly held as secretary general of the Confederation of Mexican Workers at the organization's annual election of officers, highlight of its national convention in Mexico City. Fidel Velazquez, quondam press agent of the Confederation was elected secretary general. Though Velazquez and Lombardo Toledano are good friends, it is generally believed that Velazquez is somewhat less leftist than the former leader. But there are indications that Lombardo Toledano's influence on Mexican labor is still being felt, though he has stepped down from the Confederation.

Much discussion has been developed regarding what an announcement by Lic. Francisco Javier Gaxiola, Jr., new minister of national economy, called a "misunderstanding" and "misinterpretation of the text by certain newspapers at home and abroad" of amendments to the oil laws that President Avila Camacho submitted to Congress. It was widely published that these changes in the laws specifically allowed the participation of foreigners in the oil business, in cooperation with the government, a provision that was read as indicating an early return of the expropriated properties.

Minister Gaxiola asserts that neither in the exposition of motives for the amendments nor in the text of them is any mention whatsoever made of foreigners participating in the oil business in any form at all. The official declared that the amendments maintain the principle that oil and its exploitation and all other works connected with it must be exclusively for Mexico and the Mexicans and that the modifications are chiefly concerned with making "attractive the contracting of national oil lands on financial bases that are more in accord with our economic reality and taking into full account the nature and character of the oil industry, particularly with regard to its exploration and exploitation aspects, and the convenience that private capital have regard for all requirements that are demanded of every investor."

The minister asserted that the "belief that these amendments suppress royalties for the owners of oil lands that are covered by confirmatory concessions issued in accordance with the law of December 26, 1925, is entirely without foundation." These concessions, he explained, are in accordance with the interpretation that was given by this law with regard to the judicial recognition of the situation contracted between private interests prior to May 1, 1917, for such persons acquired their surface rights for the exploitation of oil in accordance with the laws of 1884, 1892 and 1909. The present conception of royalties to holders of confirmatory concessions is not at variance with the most recent ruling of the supreme court that oil belongs directly to the nation, but that the nation allows private interests to exploit oil. This ruling established that there shall be full protection to those who enjoy recognized rights to oil lands.

"With regard to the amendment that calls for the suppression of royalties under ordinary concessions, this measure seeks to clarify the law and to eliminate certain contradictions. The system of granting these concessions, as the law of 1925 established, is fundamentally different from that governing the issuance of confirmatory concessions. The suppression of royalties for the ordinary concessions is in every case to be in strict accordance with the precepts of the law of 1925."

The Confederation of Mexican Workers were reported as opposed to the amendments in the belief that this portion of the amendments would weaken the revolutionary government by affording an opening for the restoration of the properties to the expropriated companies. This belief, it is reported in other sources, was erroneous as the provision was intended to make possible a deal with an unnamed American concern to sell in the United States Mexican gasoline, bunker fuel oil and asphalt. This reported transaction however, is said to have since collapsed.

The proposed amendments were finally approved as originally submitted and now permit the investment of foreign capital in Mexican companies subject to certain restrictions and provided the Mexican government also holds a certain percentage of the stock of such companies.

While reports appear from time to time, frequently emanating from Mexico City, that negotiations are under way between the Mexican government and the international oil companies for settlement of the dispute over the seizure of their properties, the fact appears to be that no such negotiations have taken place for a year past. Possibly the reports are designed to forestall further action or protests by the Department of State in Washington by giving the impression that the controversy is on the road to settlement. Undoubtedly there are many sober-minded Mexicans, including possibly some government officials, who would like to see the former holders of the properties restored to charge, not as owners but as operators for a specified term of years. Such an arrangement, they feel, would relieve Mexico of the charge of confiscation, and would enable the oil industry to become once more a large contributor of federal revenue instead of being as now, a drain upon the treasury.

Such views, however, are not likely to prevail in the near future. The labor party dominates the political situation and is still swayed by communistic minded leadership. It would violently oppose any move to return the oil properties to the management of the ousted companies. Meanwhile the question remains as to how long the weakened economy of Mexico can sustain the heavy losses that appear inseparable from government operation of the oil industry.

CRITICS CITE DECAY OF MEXICAN INDUSTRY

SEVERE criticism of the conduct of the Mexican oil industry under government management and control is contained in the report of a commission of experts under the title *"Comision Pericial en el Secundo Conflicto de Orden Economico de la Industria del Petroleo"*, more commonly referred to as the *Comision Pericial*. This report, prepared by three well-known Mexican engineers, deals with the subject not in its political aspects but from the viewpoint of technical operation and provision for the maintenance of efficiency.

While the report goes at length into a comparison of costs and operating efficiency under the government regime and under the previous period of private management, the section of chief interest to oil men generally are those relating to production and refining operations and the financial results of government control. Some of these comments, taken from the report published in recent issues of *"Revista Financera"* and *el Economista"*, point out failures to maintain adequate reserves and to keep refineries in a state of operating efficiency.

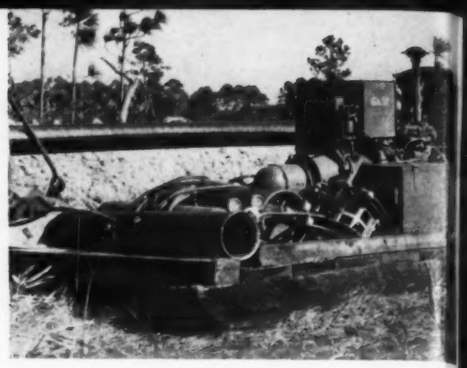
On the subject of reserves the Comision Pericial sets forth that at the date of expropriation the estimated reserves were as follows:

District	Million Bbl.
Panuco	70
Faja de Oro	60
Isthmus of Tehuantepec	45
Poza Rica	500
Total	675

In the three years since expropriation 110,000,000 bbl. have been extracted, leaving a theoretical reserve of about 565,000,000 bbl., or enough to last for about 17 or 18 years at the present rate of extraction. It is pointed out, however, that with the inevitable decline in production, the fields are approaching a time when the rate of withdrawal will become very slow under present methods. The industry therefore faces a prospect of a curtailed yield that will not supply internal needs, let alone a surplus for export, unless new reserves are found. But practically no exploratory work has been done since expropriation and no such work on an adequate scale is in immediate pros-

(Continued On Page 31)

NATIONAL DEFENSE
Issue Raised by Georgia Pipeline Ban



Federal Administration Urges State to Withdraw Opposition to Pipelines Needed for Preparedness Program — Cole Committee Investigates Obstruction

BECAUSE of its bearing upon the problem of national defense the controversy over the construction of pipelines through the southeastern states came to occupy the chief attention of the Cole sub-Committee of the House Interstate Commerce Committee in the later stages of its protracted investigation of the oil industry. It is now expected that this will form the main subject of the committee's report to Congress on May 1 and perhaps will be the only one on which immediate legislative action will be recommended.

The defense feature of the matter was brought up in a report of the Council for National Defense submitted in September, 1940. It assumed public importance on February 6 when the President addressed a communication to Chairman Lea of the House Interstate Commerce Committee calling attention to the fact that "completion of one gasoline pipe line and the commencement of another" was being delayed by opposition from other carriers in interstate commerce, and by his letter to Governor Talmadge of Georgia urging that the state authorize the crossing of railway rights of way. It was brought to a head by the adjournment of the Georgia legislature without taking action on the subject.

The two lines involved are those of the Southeastern Pipe Line Co., which is jointly owned by Pure Oil Company and Gulf Oil Corporation, and the Plantation Pipe Line Co., in which the Standard Oil Company of New Jersey, Shell Oil Company and Standard Oil Company of Kentucky are interested.

The Southeastern pipeline is projected to extend from Port St. Joe, Florida, on the Gulf Coast, to Chattanooga, Tenn., by way of Albany, Macon and Atlanta, Ga., a distance of 448 miles. Construction has been completed from Port St. Joe to Bainbridge, Ga., about 100 miles. Other parts of the line have been built or pipe has been strung, but it cannot be put into operation because of gaps caused by the refusal of railway companies to permit the crossing of their rights of way. The diameter of the line from Port St. Joe to Atlanta is eight inches and from Atlanta to Chattanooga, six inches. Its daily capacity will be 18,000 bbl. which could be increased to 30,000 bbl. with additional pumping equipment.

The strategic value claimed for this line is due in part to the fact that it is near the Pensacola naval base and passes within a short distance of important army posts at Forts Benning, Oglethorpe and McPherson.

Plantation Pipe Line Co., of which C. R. Younts is president, was organized in 1940 to build a line connecting with the refineries of Standard Oil Co. of Louisiana at Baton Rouge and the Shell Oil Co., at Norco, La., and extending across the states of Louisiana, Mississippi, Alabama, Georgia, South Carolina and North Carolina, with a branch extending into Tennessee. The northeastern terminus of the line will be Greensboro, North Carolina. Branch lines of the main system are projected to extend to Birmingham and Montgomery, Ala., Macon and Columbus, Ga., and Chattanooga and Knoxville, Tenn.

The total length of the line is 1,262 miles, about equal to that of the famous Iraq pipeline in the Near East. This includes 794 miles of main line and 468 miles of laterals. The main stem will consist of 435 miles of 11-inch pipe and 359 miles of 9-inch, while the branches will include 214 miles of 6-inch and 253 miles of 4-inch pipe. Fourteen pump stations and seventeen terminals are planned for the system. The initial capacity of the line is to be 48,000 bbl. daily which is capable of being stepped up to 72,000 bbl. if necessary. The estimated cost of construction is over $15,000,000.

Testifying before the Cole committee R. T. Haslam, vice president and general sales manager of Standard Oil Company of New Jersey, said that the Plantation Pipe Line was to be built in order to assure a dependable supply of petroleum products to the southeastern area of the United States in case there should be an interruption of ocean tanker movement to Atlantic seaboard ports. There was, he stated, no other pipeline in this section except the partially completed Southeastern line. If used wholly as a gasoline carrier the system could transport about one-half the gasoline requirements of the states of Mississippi, Alabama, Georgia, South Carolina and North Carolina.

At the present time, Mr. Haslam explained, 89 percent of the volume of products which the line would transport moves wholly or in part by ocean tanker and barge, and only 11 percent by rail alone. The line would divert most of its traffic from water carriers, but there would be some effect on the movement and direction of short haul traffic by rail. Construction of the line would release six tankers and a number of barges now serving South Atlantic states.

As to the relation of the projected pipeline to national defense Mr. Haslam said: "The territory which will be served by the Plantation system is an important one in the re-armament program. Located in the area are 30 airports suitable for use by military aircraft as well as 18 army camps completed or in progress of construction. In addition, it appears that the military and naval policies dictate that a great number of schools for primary training of army and navy air pilots are, and will be, located in the states of Georgia, Alabama and the Carolinas. Of the total U. S. Army's indicated awards for aviation gasoline for continental U.S.A. in the first half of 1941, 17 percent is in the six major states to be served by the Plantation Pipe Line. The government's fuel demands in this area will be greatly increased by the preparedness program, and there will be an expanding demand from civilian schools operating under army contracts. Adequate and dependable sources of supply become of paramount importance to such widespread military operations. The Plantation system with its input base load of 48,000 bbl. per day of refined products received directly from refineries located at or near the crude oil production areas, will be in an excellent position to meet any and all demands made upon it."

Referring to the obstacles encountered through railroad opposition, Mr. Haslam said:

"The preliminary work on the Plantation Pipe Line system has been in progress for approximately one year. Applications have been presented for permission to install the pipeline underneath and across railroad rights-of-way. Such applications were made to twenty-four separate railroad companies asking for a total of eighty-one crossing permits. All applications have been denied except the application to one railroad for one crossing. It is apparent the laws of Georgia in their present state do not permit the Plantation Pipe Line Company to exercise the right of eminent domain as a means of procuring the privilege of crossing the railroad rights-of-way. The laws of all states other than Georgia and South Carolina traversed by the Plantation Pipe Line Company's line permit it to exercise the right of eminent domain to procure the right to cross railroad rights-of-way. Litigation to establish the pipe line company's ability to cross railroad rights-of-way in such other states will be shortly commenced. The completion of such litigation will delay the construction of the Plantation Pipe Line Company's contemplated pipeline for at least six months."

Under normal conditions, Mr. Haslam stated, "assuming uniform receipt of materials and equipment and the necessary labor seven to eight months would be required to complete the

Southeast pipeline under construction from Port St. Joe to Georgia: construction stopped in Georgia due to state refusal to exercise right of eminent domain on behalf of pipeline companies.

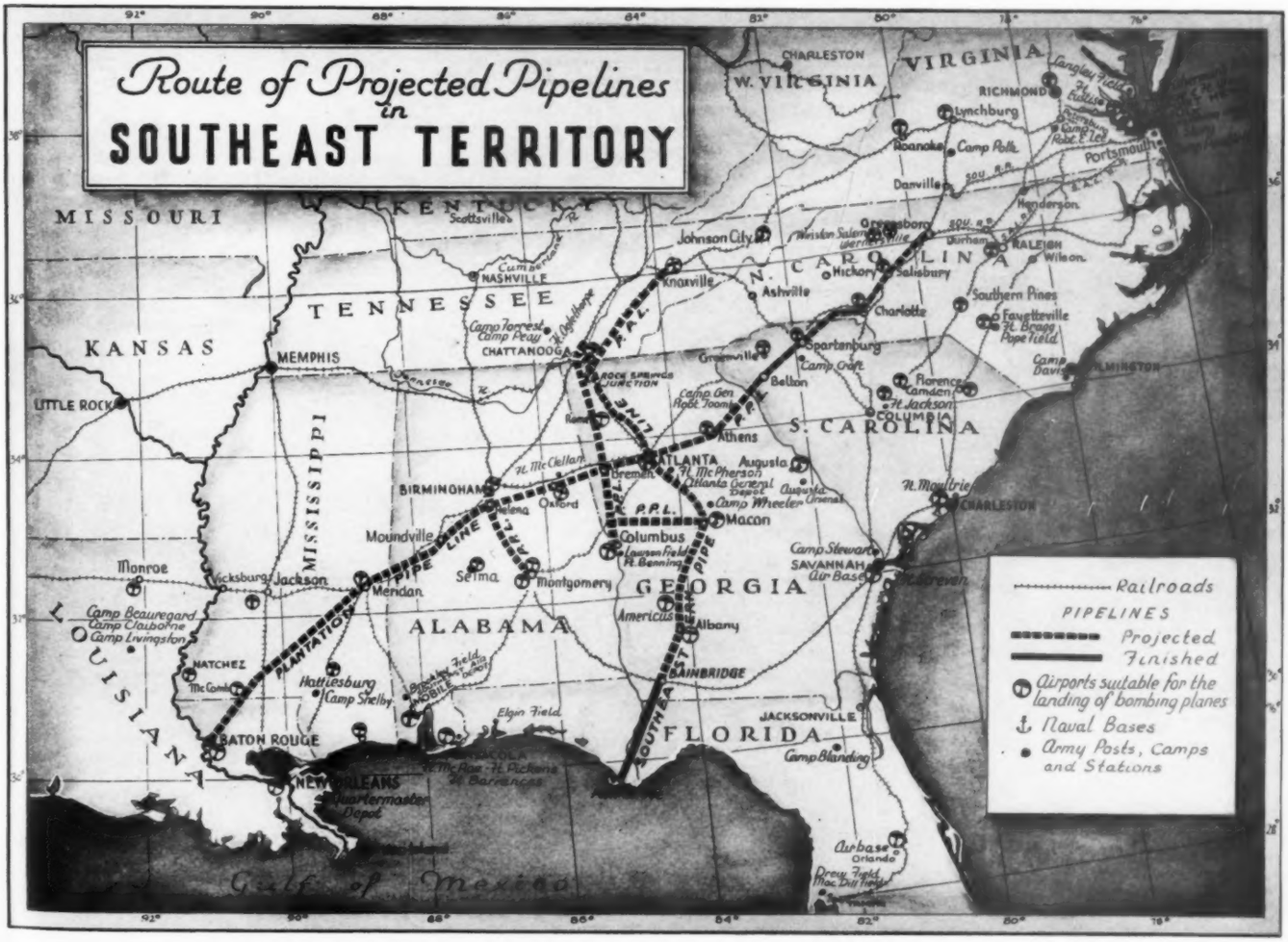
line ready for operation. Under a rush construction program, such as might be required by an emergency, the line could be placed in service in five to six months time after pipe deliveries."

This phase of the subject had been touched upon previously during the hearings in the testimony of Dr. Robert E. Wilson, petroleum consultant to the Office of Production Management. After stating that the production and refining facilities of the oil industry were more than ample to meet the demands of any national emergency Dr. Wilson continued:

"The only possible bottleneck which gives us concern is in tanker transportation to the East Coast. About 95 percent of the petroleum products consumed by the East Coast is delivered by tanker, either in the form of crude or refined products, and mainly from the Gulf Coast. The movement from the Gulf Coast alone amounts to about 1,200,000 bbl. per day, and requires a fleet of about 260 domestic tankers."

This tanker fleet, Dr. Wilson pointed out, is adequate under normal conditions for the movement, but many of the ships were built during the first world war and a number have been transfered to the Navy and into foreign service.

"In the event of naval war in the Atlantic, which might result in the loss of some tankers and necessitate the use of convoys there undoubtedly would be serious difficulty in supplying civilian requirements on the East Coast," he explained. "For this reason we have been urging the industry to relieve the situation by all possible means. Such means include the building of more storage on the Atlantic seaboard, the building of more tankers, twenty-five of which are expected to be delivered dur-



Welding the line as it started into Georgia in Baker county. Note slack in line at left.

ing this calendar year, and the building of any pipelines or barge transportation facilities which can be undertaken by private capital to help supply the East Coast without involving the tanker haul around Florida."

Referring to the projected pipelines in the southeastern area, Dr. Wilson said:

"The construction of such lines is definitely desirable from a defense standpoint. To permit one interstate carrier to block the right-of-way of another interstate carrier especially under the emergency conditions we are facing, is indefensible.

"Pipe lines also have the advantage of being less vulnerable to hostile attack and more easily repaired than most other methods of transportation. While the railroads and trucks could handle the amount of oil which would be carried by any one or two pipelines, the cost of transportation would be two or three time as much, and to be properly prepared for an emergency in the Atlantic we need to augument all methods of transportation to the East Coast. The southeastern section is the only part of the country that does not have the benefit of pipeline transportation.

"It seems fortunate that it is possible to have such facilities constructed by private capital if the legal obstacles can be eliminated. It is difficult to understand the unwillingness of the Georgia legislature to pass the necessary enabling legislation in view of the recent united recommendation of the President and the Secretaries of War, Navy and the Interior, but it would seem that it must be based on a lack of appreciation of the seriousness of the situation."

A. S. Clay of Atlanta, counsel for the Southeastern Pipe Line Company, told the Cole committee that there was ample legal precedent for Congress to enact legislation authorizing the two specific lines in the interest of national defense if it did not wish to deal now in policy-making legislation according all pipelines the right of eminent domain in interstate commerce.

The witness referred again to the letter President Roosevelt wrote to Governor Talmadge

One of the efficient wrapping machines making the line corrosion resistant.

of Georgia urging the state legislature to pass enabling legislation which it refused to do before it adjourned a biennial session not to meet again until 1943.

"The President's conclusion that the construction of all such facilities by private capital is directly in line with the present program for national defense" said Mr. Clay, "should be enough to bring about action by Congress."

Representatives of the railways operating in southeastern territory attacked the claim that the proposed pipelines were necessary to national defense, asserting that the lines were projected primarily to serve the needs of the civilian population. They declared also that th building of the lines would draw a substantial amount of traffic away from the railways which they could not afford to lose and might increase unemployment.

W. L. Stanley, vice president of the Seaboard Airline Railroad, told the committee that the entire amount of oil transported from the Gulf ports to Norfolk and Atlantic ports south of Norfolk from January 1, 1940 to October 31, 1940 could have been handled by one-half of the idle tank cars in that section during that period.

He also differed with former witnesses as to the attitude of army and navy officers on the need of pipelines as national defense projects, and introduced a letter from Admiral Stuart dated January 24, 1941, addressed to Representative Coffee of Washington, in which Admiral Stuart said that he did not regard the Southeastern Pipe Line Company's line from Port St. Joe to Chattanooga as "vital and necessary to the national defense program so far as the Navy Department is concerned."

Another communication from Brigadier General C. D. Hartman of the Quartermaster Corps, said his office was "not interested in the establishment of pipelines." In view of the position taken by the President and the National Defense Advisory Commission it was suggested that Representative Coffee's request for information be referred to the commission.

Other statements in opposition to any action by the committee in the pipeline matter were presented by A. B. Conger, a district counsel for the Seaboard and H. H. Haines, representing railroad interests at Panama City, Fla.

In Washington official circles the opinion seems to be that the growing seriousness of the tanker situation during the past few weeks has given increasing importance to the construction of the projected pipelines as a means of relieving tanker transportation from the Gulf Coast to Atlantic Seaboard ports. A secondary consideration is the need of direct pipeline connection to storage points selected by army and navy officials for the accumulation of fuel stocks. While some members of Congress are opposed to establishing a precedent of federal interference with control by the states of their internal affairs, it is felt that action in this particular instance may be required.

Mexican Oil Industry

(Continued From Page 27)

pect. The companies took all their geophysical and geological experts and their equipment out of the country. There is a complete dearth of native personnel trained for this work and practically no equipment. To continue oil prospecting on the previous scale under private management Petroleos Mexicanos, being now extremely short of capital, will have to call on the public treasury for extensive loans.

When the companies withdrew, all their refineries were operating at about normal. Reporting in November, 1940, the Comision Pericial sets forth in great detail the results of a thorough inspection of these refineries. Every major piece of equipment was looked at and rated as being in "good", "regular" or "bad" condition. In practically all cases the "bad" category was predominant. After setting forth these findings the Comision Pericial says:

"From all this it will easily be understood that the equipment of Petroleos Mexicanos should be replaced in its entirety if it is to continue the complete and efficient service required of the industry. This will require an appropriation of 300,000,000 pesos (or over $83,000,000 figuring the dollar at 3.60 pesos). Manifestly Petroleos Mexicanos is of itself unable to spend that much money."

The poor state of the equipment is ascribed to neglect to make necessary repairs and to replace units that have worn out in the normal course of operations. At the time the experts finished their report the throughput of the refineries had dropped, directly because of deterioration of equipment, to less than 60 percent of what it was when the companies were ousted. Cost data are given, which show that the expense of processing a cubic meter of crude oil has risen in the same proportion.

As a direct result of their state of disrepair, the Mexican refineries have become unable to supply enough gasoline for domestic consumption. In order to meet the home demand Petroleos Mexicanos has been obliged to load its tankers with Mexican crude oil, ship it to refineries in Houston, Texas, and to ship the refined products back to Mexico. It is estimated that this operation imposes on Petroleos Mexicanos a loss of 5,000 pesos a day. This situation represents a marked reversal of pre-expropriation conditions. In 1937 only 29 percent of total exports was in the form of crude oil; the rest was in form of manufactured products. In 1939 the proportions were 64.5 percent and 35.5 percent. In other words, through the decay of its refineries, the Mexican oil industry is slipping back to the condition of an extractive industry.

On the financial phase of operations the Comision Pericial makes the following comparison between the periods of private and government control:

In 1936, last full year for which the companies made reports, they showed a total net profit of 20,000,000 pesos. Mexican accountants, however, asserted that the actual earnings were 53,000,000 pesos. In 1939 Petroleos Mexicanos, on nearly the same volume and value of production, closed the year with a net loss of 21,000,000 pesos. Taking these two sums into account the Comision Pericial figures that the state controlled concern lost 74,000,000 pesos; in this computation Petroleos Mexicanos is not charged with interest on the 346,000,000 pesos of capital under its management.

The Commission Pericial asserts that much of the loss under government operation is due to political factors, which have dictated an excessive increase in the number of workers on the payrolls, and large increases in wages and social benefits.

The answer to these charges in official circles is an admission that exploration for new sources of supply and improvements in refinery equipment have not received adequate attention. This, they say, has been due to lack of available funds for which the loss of export markets is primarily responsible. In the case of refinery reconstruction they assert that inability to obtain replacements has been due in part to a "boycott" on the part of the ousted companies. These deficiencies, they declare, have been recognized in successive reports including the recent one by Sr. Buenrostro, and will be remedied, if necessary by government appropriations.

A Book of Valves.

THE new Catalog F-8 of the Henry Vogt Machine Company is a sixtieth anniversary edition. This of itself implies that when a firm has won a place in a chosen line of service and has held that place for 60 years (1880-1940), its catalog will be pretty sure to place before those who consult it the best fruit of the art to which it pertains.

This catalog is devoted to drop forged steel valves, fittings and flanges. On its 19-acre site the Henry Vogt Machine Company also manufactures oil refinery and chemical plant equipment, water-tube and tubular boilers, ice and refrigerating machinery and heat exchangers. These latter products, however, are not represented in this catalog, which is a book on valves.

Valves are undoubtedly among the most important of all the gadgets employed in chemical industry (which includes the petroleum in-

(Continued On Page 64)

Recent Discoveries in Alberta Suggest Wide Extension of Fields

By Joseph S. Irwin

Petroleum Geologist

Finding of Oil in Steveville Area not Conclusive of Commercial Production but Exploration Thus Far Points to Existence of Oil and Gas Over Large Plains Area.

WITHIN the short period since the completion in January, 1941, of a well rated at 521 bbl. of oil per day on an eight-hour test, near Princess, Alberta, by the Standard Oil Company of British Columbia, subsidiary of the Standard Oil Company of California, interest in the general possibilities have become international in scope. In consequence of this interest the writer has been asked to prepare an article discussing briefly the significance of the discovery, not only relative to the development of a field immediately surrounding it, but also as an indication of potential production in other parts of the plains region of Western Canada.

With these purposes in view, the writing of this article is undertaken, but at the outset the writer desires that it be clearly understood that until the results of an extensive production test now in preparation are known it would be premature to assume that a paying well, much less a new oil field is assured. Nevertheless, the occurrence of oil in material and possibly in paying quantity in other wells recently drilled by the Standard and other companies on the same structural uplift, and demonstration by these several wells of the existence of a large gas reserve seem to warrant some optimism. In any event, the results have caused Anglo Canadian Oil Company to drill three wells and start a fourth, and the Standard Oil Company of British Columbia to drill four wells and rig up for a fifth. Other companies are preparing to drill.

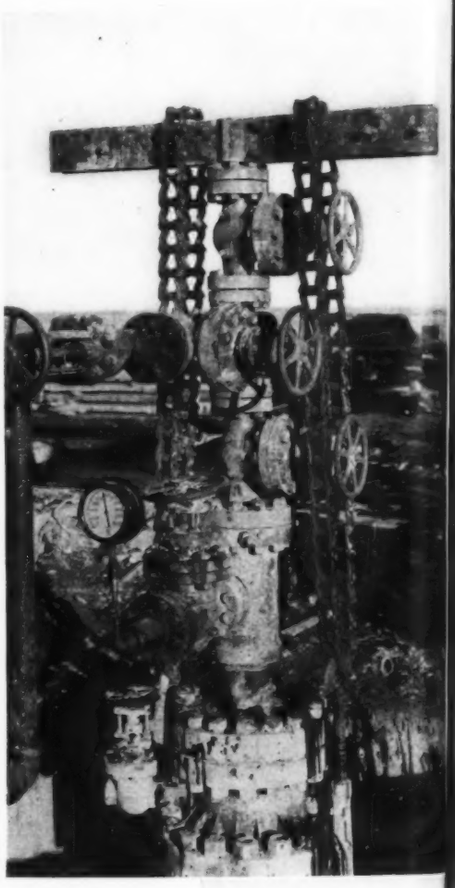
CONCLUSIONS

The principal conclusions of this article are, in the order of their demonstration or occurrence:

The existence of a northwest-southeast trending area of structural uplift, indicated by surface geology and by correlation of well records, has been confirmed in a general way by reflection seismic survey, and proved by the drilling of seven deep wells.

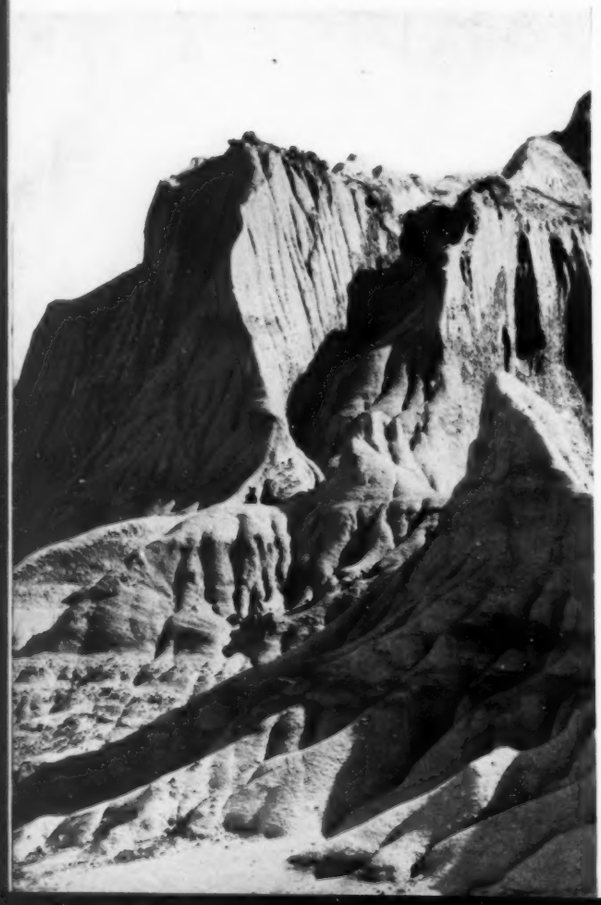
Anglo Canadian Oil Company, Limited, proved the existence of a major gas reserve on the structure in the basal Colorado (approximate Dakota) sand of Cretaceous age, at depths between 2750 and 2950 ft., under 1160 lbs. per sq. in. pressure, in three widely separated wells. Anglo Canadian also demonstrated the occurrence of gas and oil in large volume and under high pressure in the unconformable contact zone between the Lower Cretaceous and the Madison (Mississippian) limestone at 3250 to 3330 ft. Unfortunately, however, blowouts followed by the appearance of salt water in their structurally highest and most promising wells, namely Anglo No. 2 and Rainy Hills No. 1, apparently discouraged Anglo Canadian from making complete and adequate tests of the substantial oil showings, and their wells were shut in as gas wells.

Standard Oil Company of British Columbia, encouraged by the volumes and pressures demonstrated in the Anglo Canadian wells, and possibly constrained thereby to recalculate and reinterpret their earlier somewhat confusing seismic data, renewed options and leases which they had allowed to lapse and drilled their Princess wells No. 1 and No. 2, which have respectively demonstrated oil and gas in material



Well head equipment on the discovery well.

Note rugged character of the terrain near the Steveville discovery.



quantity in limestone of Devonian age at depths between 3970 and 4215 ft., and in the Madison (Mississippian) limestone at depths of 3220 to 3290 ft., under 1400 lbs. per sq. in. pressure at the casing head.

Whether or not Standard Princess No. 2 maintains oil production in paying quantity when adequately tested, and whether or not a new oil field finally results, it would appear that the demonstrated volumes and pressures of oil and gas give reason for the expectation that where satisfactory traps are provided by geologic structure, or by circumscribed areas of porosity, or by favorable stratigraphic conditions on the western Canadian plains, oil and gas in paying quantity may be found. Some of these more favorable areas doubtless lie at greater depths, but large areas exist on the plains where the depths of the various Cretaceous, Mississippian, and Devonian oil and gas bearing horizons above mentioned as occurring between depths of 2750 and 4200 ft. will be found no deeper, and there are some areas where they may occur several hundred feet nearer the surface.

Because of the present lack of market for fuel gas, and because of the more immediate economic value of oil, there is naturally more interest in oil than gas. However the prevalent failure to recognize the potentialities of gas utilization for the manufacture of carbon black, chemicals, explosives, and high octane gasoline would appear to be a shortsighted attitude.

When the full potentialities of the gas reserve are realized by development of all cognate industries the resultant benefits to Canada may well outweigh the value of large oil production.

LOCATION

The Steveville district of Alberta is located 110 miles southeast of Calgary and 120 miles due east of the Turner Valley oil field, Canada's only major oil field and source of approximately 96 percent of all Canadian oil production. The distance to Saskatchewan refining centers at Moose Jaw and Ragina is approximately 300 miles, and to the Montana boundary 115 miles. The district is traversed by the Bassano-Empress-Swift Current branch of the Canadian Pacific Railway which line constitutes a loop or relief route to that section of the main transcontinental line between Swift Current, Saskatchewan and Bassano, Alberta.

Much of the gas and oil area indicated by Anglo Canadian and Standard Oil Company wells is on a solid block of Canadian Pacific Railway Company oil and gas rights and the railway company stands to benefit largely by extensive development of oil and gas, not only on its own lands but, by reason of increased traffic, on Crown (Government) lands. It has been the traditional policy of the railway company to avoid promotion of gas discovery and development because of competition with coal but it would appear that the ultimate potentialities of gas in modern industrial development can scarcely be overlooked much longer.

Approximately 800,000 acres, solidly blocked, are held under lease or reservation in the district, most of which have possibilities to greater or less degree. The area which appears to be proven for gas and to have better than ordinary possibilities for oil, due to the fact that it lies as high as or higher structurally than existing wells covers approximately 300,000 acres.

SUMMARY

The most significant facts concerning developments in the Steveville district to date are:

(1) Occurrence of 35 deg. gravity sweet oil in substantial but not yet demonstrated commercial quantity in limestone of Devonian age under pressure of 2,200 lbs. per sq. in. at depth of 4,000 ft.

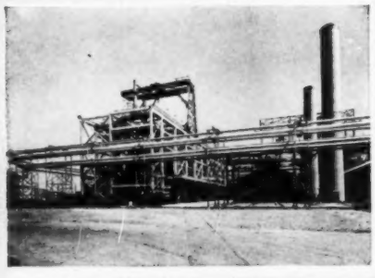
(2) Oil of 26.3 deg. gravity and gas under pressure of 1,400 lbs. per sq. in. at and slightly below the unconformable Lower Cretaceous-Mississippian contact at depth of 3200 ft.

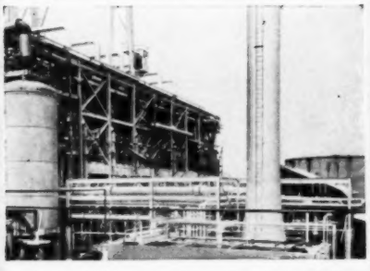
(3) Lean gas (150 imperial gallons per million cubic feet), under 1160 lbs. per sq. in. pressure, proved over a large area in the lower Colorado (Cretaceous) sands at depths between 2750 and 2950 ft.

Finally, the point of chief significance appears to be that a very large area, comprising the plains of Alberta, Saskatchewan, and Manitoba, is underlain by the oil and gas bearing formations herein mentioned. With the factors of high pressure, petroliferous character, and moderate depths demonstrated, continuation of exploration and development appears warranted in the expectation that where structural, stratigraphic, or porosity traps are favorable, other oil and gas fields will be found.

Drilling equipment dismantled after completion of the Standard of British Columbia's producer.

CALIFORNIA





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What Shall Be Done About PRORATION?-I

By Dr. O. W. Willcox

How to obtain an effective application of the principle of proration without subjecting the entire operation of their industry to direct government management is a problem that has long troubled thoughtful oil men and is still unsolved. A possible alternative, according to the author of the accompanying discussion, may be found in the experience of the sugar industry in which a system of self-administered control sanctioned by governmental authority has been found to be workable in a number of countries over a period of years. In a series of three articles of which this is the first, the operation of this system and its possible application to petroleum will be set forth.

Adhering to the familiar radio formula the editors of World Petroleum state that the opinions expressed are the author's own and do not necessarily reflect the opinions of this publication. Without attempting to pass on the merits or the practicability of the system described they feel, however, that members of the oil industry will be interested in knowing just what is involved in the method of regulation applied to another world wide industry, though it should be mentioned perhaps that the system described is not the one employed for sugar control in the United States.

AT THE present time, and aside from developments as yet unknown that may flow out of the defense situation, the petroleum industry of the United States is beset by at least two unpleasant circumstances.

On the one hand is the lack of good fit between production and consumption, with production showing a strong tendency to outrun consumption. The petroleum industry is, in fact, a saturated industry, in the sense that it possesses more than enough raw material, and more than enough manufacturing facilities to supply whatever demand presents itself; and this condition holds in spite of the fact that the demand for petroleum products is continually increasing. Every year more automobiles take to the road, more airplanes take to the air, more fuel oil takes the place of coal and more petroleum hydrocarbons are consumed by the chemical industries. But the urge of the consumers to use petroleum products never gets the upper hand of the zeal of the oilmen to supply the goods. The result is that the petroleum market is and for a long time has been a buyer's market, in which the producers have more to sell than the public will buy.

The best evidence that the petroleum industry is virtually a saturated industry is afforded by the struggle which the industry has been making against the condition of over-saturation that afflicts it. The oilmen would be happy indeed if their industry were merely saturated, with production always nicely balancing consumption. But, the producers are continually overshooting that mark. They are continually discovering new oil reserves and are throwing or trying to throw more oil on the market than the public can take. In an effort to keep from being drowned in the flood of its own product the industry has invented for itself a device called proration. This is a device that is intended to keep the excess of oil away from the market; or, stated otherwise, to permit only that amount of oil which is really needed to enter the channels of trade.

Dr. O. W. Willcox, author of the accompanying article, whose many years of study devoted to proration in the sugar industry has suggested an extension of this system to the petroleum industry.

CENTRAL PRINCIPLE

In so far as it is conceived and practiced by the petroleum industry (or we should say, in so far as the industry has been able or is allowed to develop it) the central principle of proration is that the oil business belongs to the whole industry; that is, each producer has an equitable share in the market for petroleum in proportion (*pro rata*) to the size or capacity of his oil-producing property. The necessary converse of this proposition is that no producer is in equity entitled to more than his share. If he succeeds in forcing more of his own product into consumption he by that much deprives other producers of some part of their outlet, because the market will take only a certain maximum quantity. It is on this principle that various oil-producing states—Texas, Oklahoma, Kansas, etc.—have erected proration systems having the force of law, by which the owners of oil wells are limited to certain allowables that correspond more or less accurately to what is thought to be their respective shares of the business.

This system has been found good as far as it goes, but every oilman will admit that it does not go as far as could be wished. The enthusiastic wildcatters, with and without the benefit of scientific direction, are putting down more holes that tap more oil pools, and every new producing well and every new pool adds to the flood that presses on the pipelines. Meanwhile, the public's ability to consume oil does not correspondingly expand, so the only way to maintain a semblance of balance between production and consumption is to reduce the allowables, many of which have approached and even passed the point at which wells can pay their way.

The proration picture would be more satisfactory if all the producing interests could be induced to line up with those who respect the principle that the oil business belongs to the whole industry, and that no man in it is in equity entitled to more than his proportionate share. But although more than a preponderant majority of the American petroleum industry has been sold on proration,

there are still some outsiders who greatly trouble the situation. These outsiders are well satisfied to let the others keep their surplus oil off the market, leaving the outsiders room for all that they themselves can produce. The more oil these outsiders throw on the market the more the allowables of the cooperating, square-dealing producers are reduced.

How to develop the existing groundwork of proration in the oil business into a more perfect system that will be of country-wide application is now one of the major headaches of the petroleum industry.

In the meantime the industry has been acquiring another headache from a different quarter. The government of the United States, or at any rate some highly placed and influential officials in the government, profess to find serious fault with the present structure of the industry and the way it is carrying on its business. It is accused of concerting measures for stifling competition so that it may gouge the consumers of petroleum products. The industry is also accused of wasteful practices that are dissipating the irreplaceable national oil reserves, practices that are hastening the day when there will be no more producing wells to supply natural gas, gasoline and lubricating oils. These officials take the stand that since the petroleum industry is unable or unwilling (or both) to treat all its members and the public fairly, and is not properly discharging its function as the steward of a precious national resource, the government will be obliged to take a hand and put these matters to rights. This official view has crystallized in a statement, attributed to Secretary of Interior Ickes, that it will be necessary for the government to "regulate the petroleum business from oil well to filling station". Some details of what is proposed are more or less clearly revealed in a projected law, known as the Cole bill, that is being urged on the Congress by high authorities in the government. On the whole, the petroleum industry finds the Cole bill not to its liking. The federal hand that is to be laid on the oil business will evidently not be a light one, especially as regards those measures that are actually or ostensibly aimed to achieve conservation of petroleum resources. The indicated means of attaining this object appear to take operating control out of the hands of the oilmen and lodge it in the hands of federal agents, who may or may not understand the best interests of the public or of the producers.

Undoubtedly the petroleum industry would thank anyone who will come forward with a constructive suggestion on how these two headaches of the industry might be mostly if not wholly relieved through action that could be taken by the industry itself.

It is a well approved maxim that the best defense is a vigorous and well-conceived offensive. Why leave the initiative to elements in the government who, with or without real justification, are attacking the industry? The proper antidote for the officially sponsored Cole bill is a bill offered from the industry itself that will accomplish the legitimate purposes of that bill in a better way. However, a project of law coming from the industry that does not have the backing of practically the whole industry is not likely to carry much weight. But a proposition endorsed by a preponderant majority of all interests, including the majors and the minors, the big fellows and the little fellows, that shows an honest intent to be fair to all elements, including the little oilmen and the public, and to which the technologists of the industry have contributed a sane plan of conservation, would be likely to command both congressional and public approval.

It is easy enough to state the general terms of a formula that if carefully worked out and followed through, should lead to a solution of the whole problem. Let the members of the whole industry get together and work out a system of proration and production control that will cover the whole country and really bring consumption and production into line. And while the industry is working at that task, let it also make an honest effort to develop a plan that will forestall any accusation from the government that the industry is unable and unwilling to practice true conservation and conduct its business genuinely in the public interest. Let the industry reduce its constructive suggestions to a form which will be acceptable to a preponderant majority (three-fourths or seven-eights) of all the interests in the industry and not unfair to the public; and let it then ask the government and the Congress to ratify this agreement and enact it into a law that will be binding on the whole industry.

TWO ALTERNATIVES

At all events, the petroleum industry is going to be run either according to wisdom generated within the body of the industry, or according to wisdom furnished and applied by the government; and the wisdom which the industry offers as a supplement or a substitute for government wisdom must reflect its collective judgment and not merely that of a limited group whose motives may be open to suspicion.

An ancient sugar mill operating in the days when adequate production was the principal problem.

This suggestion calls for a plenary conference of the whole industry, with all interests and elements represented and heard, a conference to which the conferees will come bringing with them good will and a resolve to go to the limit of forbearance and mutual concession in drafting the project of a law that will harmonize particular interest and be foursquare with the general interest.

As was said above, it is easy enough to write the general terms of a formula within which the problem might be worked out. Nearly anybody could have made the suggestion here offered, and the writer himself does not claim much credit for having made it. To pass from the general to the particular is another matter. If the representatives of all interests in the industry should meet in a plenary conference to work out an agreement for the government of the whole industry, what would or could they put into such an agreement—remembering that the agreement would have to be ratified by the written ballots of at least two-thirds or three-fourths of all the individuals representing two-thirds or three-fourths of the total producing capacity; and also remembering that the finished agreement must be of a character

such that the government could and would request the Congress to enact it into a law that will be binding on all concerned, including the small minority of dissidents? The writer of these lines does not doubt that a large number of oil men will at first be skeptical of the possibility of getting so many minds to meet on all the many points that would come up for settlement.

But if the proposition were really hopeless, or even very difficult, this article would not have been written. The identical line of action here suggested to the petroleum industry and to the government of the United States has been adopted and carried out with astonishing success in another great branch of industry that has been afflicted with situations identical in nature with the situations that now afflict the petroleum industry of the United States. The task which the writer has here set for himself is thus an easy one: it is to describe what has been done, and then leave it to the oilmen to decide whether they will make up their minds to go and do likewise. Undoubtedly, there are few men in the petroleum industry who would not willingly do their bit to extricate the industry from its present difficulties and to avoid difficulties that impend, if only they had a clear conception of what to do.

SUGAR SHOWS A WAY

In deciding on what to do in any situation it is often a great help to consider what others have already done, and how they have done it. The world's progress in all departments has been built on the accumulated experience of the past, and it is in this sense that the writer has deemed it apropos to direct the attention of American oilmen to what has been accomplished in the world-wide sugar industry.

Of course, sugar and petroleum are two quite different commodities which have very different origins and are processed and consumed under quite different circumstances, but they have this in common: They are each the basis of a great essential industry which gives employment and a living to hundreds of thousands of humans and hundreds of millions of dollars of invested capital. Both the petroleum industry and the sugar industry have become saturated industries, with strong tendencies to oversaturation. In each of these saturated industries there have arisen the same problems of adjusting competitive conditions between members of the industry, and essential relations between industry and government. The men engaged in producing both sugar and oil are, in the mass, of the same kind, quality and condition; they have the same need for employment and livelihood. The oil and the sugar industries exist not merely to supply the needs of the community, but even more importantly to guarantee the needs of the producers themselves. No man works for another except as a means of supplying his own wants, and all technological, commercial and social-economic matters, however varied they may be, must bend themselves to the prime necessity of supporting the producer in order that he may produce.

The problem of regulating the petroleum industry, or any industry, in its own and the public interest is therefore first and foremost a human problem, in which the equities between the human elements take precedence over technological and commercial details. If there is apparent conflict between equity and technology of any sort, it is technology of every sort that must be subordinated to the equity, and not *vice versa*.

It is on this principle that the world-wide sugar industry, in collaboration with the public authorities, has fashioned for itself and for its public a way of existence which this writer, a man trained in the scientific method and one who from a detached position has observed the development of the social-economics of this industry for more than a dozen years, can honestly (and advisedly) say has all the appearance of being the nearest approach to an all-around square deal that this world has yet witnessed or is soon likely to see.

In writing this article for the readers of WORLD PETROLEUM the intention is simply to state the facts, with only such comment as is required to bring out the necessary implications.

IDENTICAL SITUATIONS

The basic fact is that the sugar industry everywhere has more men and facilities for producing its goods than are needed to cover the demand. In this respect its situation exactly parallels that of the American petroleum industry. This surplus of producing capacity resulted in such pressure on the sugar market that prices were depressed to uneconomic levels, where marginal enterprises were extinguished and even the stronger units suffered loss. This also parallels experience in the oil industry. Then the sugar men began to think of ways of retrieving the situation. They were quite able to see that the trouble arose from the state of saturation of their industry, where even a slight excess of supply over demand could have disastrous consequences to the producers. In the natural sequence of such thoughts the remedy that suggested itself was to keep the surplus off the market. Oilmen, by a similar process of thinking, have reached a parallel conclusion. The surplus sugar could be kept off the market if the members of the industry would agree to limit their offerings to a quantity that the public would take. The oilmen have that idea too. It was recognized that such an agreement must have a good basis of equity, with every sugarman entitled to his proportionate share of the business at the time the agreement becomes effective. In other words, the sugar market must be prorated, on the general principle that the business belongs to the whole industry.

Thus oilmen and sugarmen, facing essentially the same social-economic condition and pursuing identical lines of thought, find themselves reaching the same conclusion about how to dispose of their difficulties. This convergence of ideas arising from such very different quarters emphasizes the general truth that the social-economic problems of industry are essentially human problems that admit of the same general solution, because human nature and human needs are everywhere essentially the same and are independent of, and above, technological details.

However, after reaching a common conclusion that proration is a proper and desirable means of overcoming or at least mitigating an unhealthy social-economic situation, the parallelism we have drawn between thought and action in the petroleum and the sugar industries begins to fade out. The sugarmen have carried the principle that the business of a saturated industry belongs to the whole industry to its very natural and logical conclusion, whereas the development of this same principle in the petroleum industry still lags far behind.

The sugarmen, working in close collaboration with their governments, have shown what can be done with the principle of proration in a saturated industry; and what they have done can be described, without exaggeration, as little short of marvelous. Not the least of these marvels is the complete harmony and unity of purpose that has been established between government and industry in some sugar producing countries. What the oilmen of the United States will surely regard as especially noteworthy is that good will and understanding, arising from a skillful adjustment of all interests and working through an appropriate organization, have been developed to such a pass that the government is content to let industry manage its own affairs, in full confidence that the equitable interest of all members of the industry on the one hand, and the equitable interests of consumers and the general public on the other hand, will be properly conserved. Imagine the petroleum industry of the United States turned footloose to govern itself and deal fairly with the public, with not a bureaucrat appearing in the picture. That is an outcome which will probably balk the imaginations of a great many people, especially those who believe that human nature (with particular reference to oilmen) must forever be kept in order by anti-trust, anti-monopoly and anti-price-fixing legislation.

But the full equivalent of this strange picture has actually materialized on a world-wide scale. If it were merely an isolated instance occurring in only one, or in a few minor sugar-producing countries, it might pass as a local phenomenon having little or no general significance. But when the system is found in more than 20 big and little sugar-producing countries distributed all over the five continents and on both sides of the equator; when we observe that this system has survived political upheavals, wars and economic depressions; and when we consider that no nation which has once adopted it for its sugar industry has ever given it up, we are entitled to conclude that here is a principle of social-economic action that is valid in spite of differences of race, religion, geography, climate or form of government (whether genuine democracy or absolute autocracy) and is conformable to human nature everywhere.

Order and stability have been achieved for the sugar industry in many parts of the world where proration has been carried to its logical conclusion.

As was said above, both the world sugar industry and the petroleum industry of the United States have traveled the same road that leads to proration. But, as we also said, while the sugar industry has forged ahead and has used that principle to reach a high degree of social-economic perfection, the petroleum industry has lagged behind. The meaning here is that proration in the petroleum industry is in a relative state of arrested development.

The situation may be summarized thus: A substantial majority of the petroleum industry wants proration and has induced a number of local governments—Texas, Oklahoma, etc.—to enact legislation to give the principle a semblance of effect. Judged by standards set in the world sugar industry, the system of proration now found in the American petroleum industry has the following principal shortcomings:

1. It is not nation-wide; the prorating laws passed by individual states have no effect beyond their own boundaries, and the oil producers of non-prorating states remain free to throw upon the market whatever amount of oil they please. Moreover, the prorating states are not always of one mind as to the proper basis of proration, especially as regards the allowables that are prescribed from time to time.

2. The amount of oil coming on for sale is out of control not only as regards the unlimited production of the non-prorating states, but also as regards new production anywhere. Whenever a new oil pool is discovered or a new well is opened in an old field, this new production may and does claim a place in the existing scheme of proration; to give the new oil its place, previous allowables must be reduced. This continual whittling away of allowables continually reduces current earnings and prolongs the time required for the operator to payout his investment, and not infrequently removes the possibility of a reasonable payout.

3. Due to the pressure of non-prorated oil and to new flush production, the visible stock of petroleum products is subject to comparatively large variation, with a strong tendency to overhang the market. Prices vary with each change in the statistical position, alternately squeezing the oil producers and the consumers. This uncertainty and instability of oil prices has a disturbing effect on the economics of investment, production, processing and consumption.

In a modern prorated sugar industry these shortcomings are not to be found because, in the first place, the system of proration is invariably made nation-wide; in the second place, there is no unlimited production from any source, either from outsiders not subject to control or from new sources; in the third place, there are no price fluctuations, which means that the flow of the product to market is steady and at all times exactly proportioned to consumption, no more and no less. In such a national sugar market visible stock and statistical position are devoid of any economic significance, and have in fact been reduced to the status of meaningless terms so far as domestic market effects are concerned.

These results come from thinking the problem of proration out to its logical end, and then going through with the job without stopping at half-measures.

CONTROLLING POINTS

Before getting down to the details of what this writer has come to believe is the most masterly piece of work that the annals of constructive social-economics have yet recorded, it will be well to restate the controlling viewpoints under which a modern system of industrial proration is thought out to the end.

1. The starting point is the principle that since production necessarily precedes consumption, the producer must enter the economic picture before the consumer. Not only must the producer come first, but after production is begun the producer must be maintained in a position to continue his work. This means that the producer must receive a price that will sustain him and keep his equipment in order. It very definitely means that the consumer shall never be allowed to procure goods or services at a price below the cost of production.

2. For the purposes of the preceding paragraph the producer is not merely one or another individual engaged in production, but the whole corporate industry of which the individual producers are members. It is characteristic of a modern system of industrial proration that the industry regards itself, and is so regarded by the public authorities, as a whole; it is with this unitary whole that the public, represented by the government, enters into contractual relations.

3. In entering into contractual relations with the unified industry the public authorities agree to the principle that the producer (the whole industry) shall receive a price that will fairly compensate it, with the proviso that neither the whole industry nor any separate elements in it shall at any time obtain a price that is exorbitantly above the cost of production figured on actual costs in each classification.

4. A member of the industry is defined as any person, partnership or corporation that, at the time the contract between the public and the industry was entered into, had obtained an established position in the industry and was contributing to its output.

5. A member of the industry has an indefeasible right to maintain the relative position (quota) he has won in the industry, and to share in the industry's business in the proportion that his previous volume of production bears to the total production.

6. The business of the industry belongs to the whole industry *as it stood at the time it was constituted as a unit*. Once the industry has been recognized as a contractual entity the membership list is closed, and is not reopened except when additional facilities for production are required to meet an increased demand, or for some exceptional reason.

7. The prices which the industry shall charge the public for its products will be named in the contract or agreement with the public authorities, and will not be subject to change except at stated periods and after prior consultation between representatives of the industry and the public; and these prices will be uniform throughout the country.

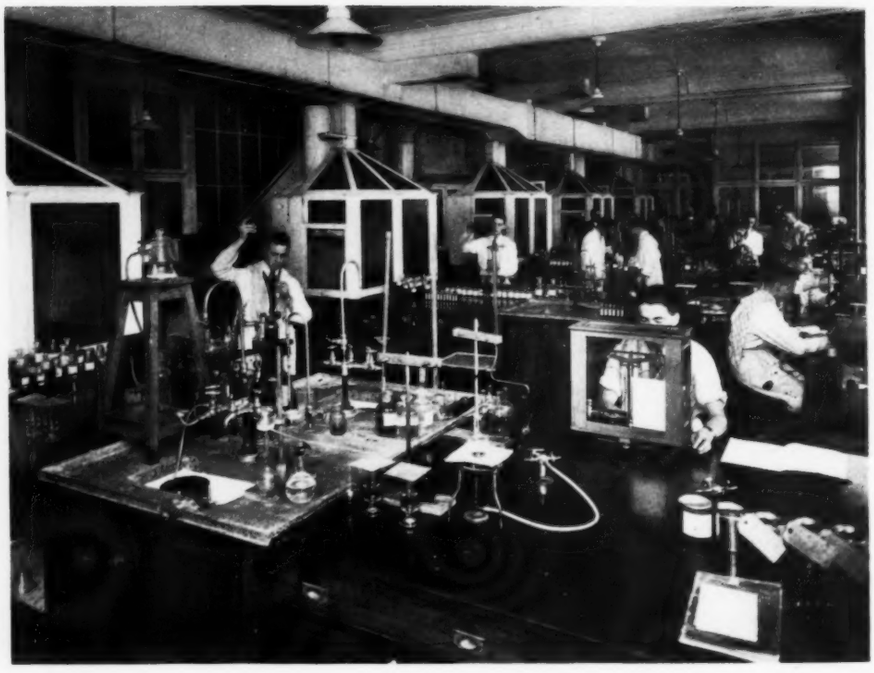
The last two paragraphs—6 and 7—involve considerations that are somewhat new to social-economic thought in the United States and may here be made the subject of a special discussion.

CLOSED INDUSTRY

According to proviso No. 6, when a prorated industry has been publicly organized and recognized as a contractual entity, its membership list is then and there closed to new entrants, except in special circumstances. The individuals, partnerships and corporations that had won established positions in the industry are now taken into a fixed guild in which membership is denied to newcomers. Or, to state the matter in blunt terms that will be universally understood, the prorated industry has become a monopoly, on which has been conferred the exclusive right of supplying the public with the prorated commodity under a definite charter from the government.

Now, monopoly is a hated word, and many American statesmen have risen to influence and power by fostering the hatred of it. This hatred is extended to practically every form of business combination, but more especially to what are called combinations in restraint of trade, by which is meant agreements among producers or dealers that throw obstacles in the way of free and unlimited competition, or which tend to restrict supply and hold prices above the natural level to which free and unlimited competition would sink them. In the rubric of the American trust-busters there is no such thing as a good industrial monopoly, and no such a thing as a combination in restraint of trade that by any possibility could be in the public interest. Freedom to compete, freedom for every man to enter any line of business he pleases and to seek a living wherever he may find it, and freedom for all consumers to cover their necessities in the cheapest of all possible markets, have long been the shibboleths of a group of politico-economic crusaders.

However, times and opinions are changing, and there is a no more challenging indication of the quality of this change than the social-economic doctrine that has become solidly intrenched in the sugar industries of more than a score of countries distributed over the face of the earth. The historical process by which this doctrine came to be fixed in this particular industry may be passed over for the moment. In sum and substance it arose out of a perception that an industrial monopoly may be made to serve vital public purposes; that combinations which exclude free competition and control prices may be indispensible features of a very sound national housekeeping; and that a price policy which considers exclusively the inter-



Full provision for continued research is made in an industry conforming to the proration system described in the accompanying article.

ests of the ultimate consumer may have definitely injurious effects on the body politic and on the consumer himself.

This new direction that has been given to applied social-economics springs from a much belated appreciation of one of the profoundest truths of all economics; there is a vast difference between the economics—both political and social—of saturated and unsaturated markets.

In an unsaturated market demand is ahead of supply. There are not enough producers and not enough producing capacity to satisfy the actual or potential demand. There are openings both for more capital and more labor; profits, jobs and wages abound, and the sum total of the national wealth is continually enlarging. The automobile industry is an example which began 40 years ago with an enormous virgin field before it. The social and political characteristic of an unsaturated industry is that so long as the stream of new consumers is surging up nobody complains of over-production or hints that it would be in the public interest to limit production.

But when the saturation point is reached and the demand has attained its peak, or when the producers outstrip even a growing demand, the economic and the social pictures radically change. New enterprises can no longer be comfortably accommodated and openings for more labor become narrower if not entirely closed. In this condition of the market even a slight excess of production sinks the price below the profit line or even below the cost line. In proportion as unconsumable stocks accumulate and the price continues its downward course, more and more marginal enterprises become extinct and the existence of even the stronger units becomes precarious. Unemployment grows; the oversaturated industry is not only unable to take care of its own but its reduced earning power diminishes its ability to buy the products of other industries.

In brief, an unsaturated industry represents business expansion, prosperity, growing employment and comfortable living; an oversaturated industry represents business depression, reduced or lost profits for capital, the loss of jobs, reduction of the standard of living, a rise of expenditures for poor relief, and political unquiet. In their social-economic effects these two conditions are as different as night and day. It is only to the first of these conditions that the maxim: "the best government is the one that governs the least" applies; the second condition calls for the steadying hand of the public to save the industry from wrecking itself and damaging the general social-economic structure, and especially to prevent it from being further overcrowded by newcomers who would ill serve the public interest by destroying the livings of individuals already faring none too well.

That is the logical end of all systems of industrial proration that are thought through to the end: limitation of production to effective demand, and closure of the industry when its volume of business is no more than sufficient to take care of its existing personnel. Proration must remain a half-measure unless it ends in the kind of monopoly here described. How such a monopoly may and does serve high purposes of public policy without harming legitimate interests has been amply demonstrated by experience in the world-wide sugar industry, as shall be pointed out in these articles.

Proviso No. 7, which is also written into the charter of every logically prorated industry, represents another remarkable new development in social-economic thought, and one that has had the effect of overturning many prevailing notions that have seemed as enduring as the Rock of Ages.

A system of limitation and proration as it is exemplified in the world-wide sugar industry takes the form of an agreement between the public and the industry. This agreement is first ratified by a referendum of the whole industry and then ratified by the legislative authority. The agreement names the prices at which the industry shall deliver its products to the consumer, and specifies that these prices shall be uniform throughout the country, so that no consumer anywhere will pay more than another at any time during the period covered by the agreement. The point here is that the public does not bargain with individual producers, but with the whole industry, which has now become an organized unit.

NEW CONCEPTION OF PRICE

In reaching an agreement as to what the price shall be the public aims to make certain that the price shall be sufficient, but no more than sufficient, to give the industry *as a whole* its costs and a reasonable profit *on the whole*. This is a definite affirmation of the principle that consumers shall never be allowed to procure goods or services below cost, because the producer must be kept in a condition such that he will be able to serve the public. Again it is to be emphasized that the producer is the whole industry, and not merely one or another individual. The public's part is to pay a fixed unit price for all of the product it consumes. The total of all these unit payments is the industry's gross income. It is the industry's part to present to the government and the legislative authority an agreement that will provide for the distribution of this total income among its members so as to assure the continued survival of all the enterprises big and little, relatively efficient and relatively inefficient, that were productively established in it on the day the industry was prorated. This resolves itself into the fact that while the public pays one fixed price, different members of the industry, by the consent and on the motion of their own colleagues, may be paid different prices for their product according to the difficulties they are under.

In all this, the public acts on the principle that while it wants its goods at reasonable prices, it will not carry its insistence on low price to the point of snuffing out the living of a single enterprise that is painfully contributing to the general supply. The ultimate consumer must pay not only the direct technological cost but also the direct social-economic cost of what he consumes; and the public insists that the industry shall find a way that will both keep the price reasonable and preserve its weaker members.

The organizational and administrative machinery by which the prorated sugar industries and their governments accomplish these purposes will be described in the following article.

Although in a sense, prorated sugar is a closed industry progress in research and experimentation is as active as ever.

LEASING CAMPAIGN SWEEPS THE DAKOTAS

Oil Companies Expand Holdings, Intensify Geophysical Activities and Plan Test Drilling — State Legislatures Enact Laws Forbidding Waste and Authorizing Conservation Practices—A Complete Review of the Geology of this Entire Province, Written by Joseph Kornfeld, Appeared in the March Issue of World Petroleum.

LEASING activity in the Dakotas which attained substantial proportions in 1940 has received renewed impetus in the early months of 1941. Oil companies, large and small, are participating in the play, as are newly organized corporations and individual investors including well known geological experts.

Estimates of the areas under lease vary from 4,000,000 to 7,000,000 acres, divided about equally between the two states. The rural credits department of South Dakota alone reports the leasing of 715,000 acres of state-owned land. Recent operations have centered largely in the central third of the two states which form part of one of the great geological basins of the country, the Lemmon geosyncline. Areas that have received special attention include Stanley, Sully, Potter, Dewey and Corson Counties in South Dakota, and Morton, Burleigh, Emmons, McLean and Oliver Counties in North Dakota. Leasing has been reported in nearly thirty counties of the two states.

Fully fifty separate companies have investigated the central area of South Dakota during the past year according to Dr. E. P. Rothrock, State Geologist. As many as 140 geologists and geophysicists have been engaged in exploratory work at one time.

While some of the oil companies have masked their operations by having leases taken in the names of their agents, others such as Carter Oil Company, subsidiary of Standard Oil Company of New Jersey, Barnsdall Oil Company and Murphy Oil Company have gone about the business openly. Other companies that are said to have had working parties in the prospective oil and gas areas are Magnolia Petroleum Co., Phillips Petroleum Co., Sinclair Oil Company, The Texas Corporation, Ohio Oil Company, Pure Oil Company, Skelly Oil Company, Gulf Oil Corporation, Amerada Petroleum Company, Stanolind Oil and Gas Company, Shell Oil Company, Continental Oil Company, Mid-Continent Petroleum Corporation, Sun Oil Company, Derby Oil Company and others. One large company is said to have checkerboarded nearly a million acres in ten or a dozen counties during the past few months. The extent of leasing operations is considered remarkable in view of the fact that neither state has commercial oil production, and that the only gas production is confined to a few wells near Pierre, South Dakota, and in the southwestern corner of North Dakota.

Developments are expected to enter a new stage this season with more extensive operations, seismographing and coretest drilling. Carter Oil Company, which last year drilled two stratigraphic tests and is drilling a third, has announced plans for a deep test on the property of the Montana-Dakota Power Company in the Marmath, North Dakota area. Work is scheduled to start about May 1 under a contract said to provide for drilling to 10,000 ft. if necessary.

The state of South Dakota is considering the drilling of a well on school endowment land. The state has large holdings of unsold school lands and of farms acquired through foreclosures of mortgages under the rural credit act. The federal government also owns land within the areas marked for exploration which never has been entered for homesteading. Four Indian reservations are located within this zone, some of the land being held under tribal ownership and some under individual allotment.

One important geologic condition that has drawn many geologists to the area is the presence of many overlaps occurring vertically between the Upper Cretaceous and the Mississippian. Considered of possible commercial significance is the Big Snowy group of upper Mississippian age which occupies roughly the west limb of the Williston basin of western North Dakota and eastern Montana. The Big Snowy group produces from two deep tests on the Baker-Glendive anticline in extreme eastern Montana. Other formations which may provide objective reservoirs in the Williston basin include the Minnelusa which has given showings of oil in South Dakota.

The Sundance-Ellis formation of Jurassic age promises to be an objective where it pinches out on the northeast limb of the basin, in North Dakota and Manitoba.

The Minnekahta limestone of Permian age is another formation which may form an objective in the greater depths of the basin. The Devonian formation, which is marked by a persistent black shale series at its upper extremity, carried saturation 90 ft. in the formation in a deep test drilled on the Baker-Glendive anticline. Montana-Dakota Utilities company's No. 1 Government, in the northeast northwest of section 17, Township 4 North, Range 62 East, topped the Devonian at 8,050 ft. and cored saturated limestone section from 8,140 to 8,185 ft. The widespread presence of good oil showings from the Devonian limestone in Montana and Alberta encourages exploration for this particular objective.

Meanwhile, across the international boundary, renewed exploration and development is underway in the northwestern limb of the Williston basin, offsetting the northwestern portion of North Dakota. Franco Oils, is initiating a development campaign in several portions of Saskatchewan based on reflection seismograph surveys prepared by Dr. C. A. Heiland and Heiland Research Corporation. These prospects, which have been leased, are in the following areas:

1. Lone Rock prospect, 20 miles southeast of Lloydminster
2. Muddy Lake prospect, 7 miles south of the Unity-Vera field
3. Northeast of the Battleview-Vermillion field

Anticipating the possibility of commercial production within their borders the state legislatures of the two Dakotas gave special attention to oil and gas legislation at their recent sessions. One act of the South Dakota legislature provides for the communitization of oil and gas leases with adjoining lands for development and operation, and authorizes trustees of estates to enter into such agreements. Another permits the leasing of school lands and including these in agreements for unit operations.

Most important of the South Dakota enactments probably was an act to create a state oil and gas board which was signed by the governor on March 7. The board consists of the governor, attorney general and state engineer. One section of the law specifies that "the production or handling of crude petroleum, oil or natural gas in such manner or under such conditions as to constitute or result in waste as herein defined is hereby prohibited." Waste is defined as physical waste as that term is generally understood in the oil industry including:

(1) Underground waste and the inefficient, excessive, or improper use or dissipation of reservoir energy, including gas energy and water drive, of any pool; and the locating, spacing, drilling, equipping, operating, or producing of any oil well or gas well in a manner which results or tends to result in reducing the quantity of oil or gas ultimately recoverable from any pool in this state under prudent operations; and

(2) Surface waste and the inefficient storing of oil and the locating, spacing, drilling, equipping, operating, or producing of oil wells or gas wells in a manner causing or tending to cause unnecessary or excessive surface loss or destruction of oil or gas.

The bill, moreover, provides that the board shall have the authority to make inquiries to "determine whether or not waste, over which it has jurisdiction exists or is imminent." To accomplish this purpose, the bill provides that the board may regulate shooting, acid treatment, secondary recovery methods, well spacing, oil and gas production records, notice of intention to drill, stratigraphic tests, and plugging report filing, and drilling records filing.

On March 7 a series of oil and gas laws was adopted by the legislative assembly of North Dakota.

Most significant of these was "an act to conserve crude petroleum, oil and natural gas; to enlarge the duties and authority of the Industrial Commission, to supervise and control the oil and gas resources of North Dakota; authorizing the commission to promulgate rules and regulations for enforcement of the provisions of the act for the purpose of conserving oil and gas; providing penalties for the violation of certain provisions or of the regulations promulgated thereunder; repealing all laws and parts of laws in conflict herewith."

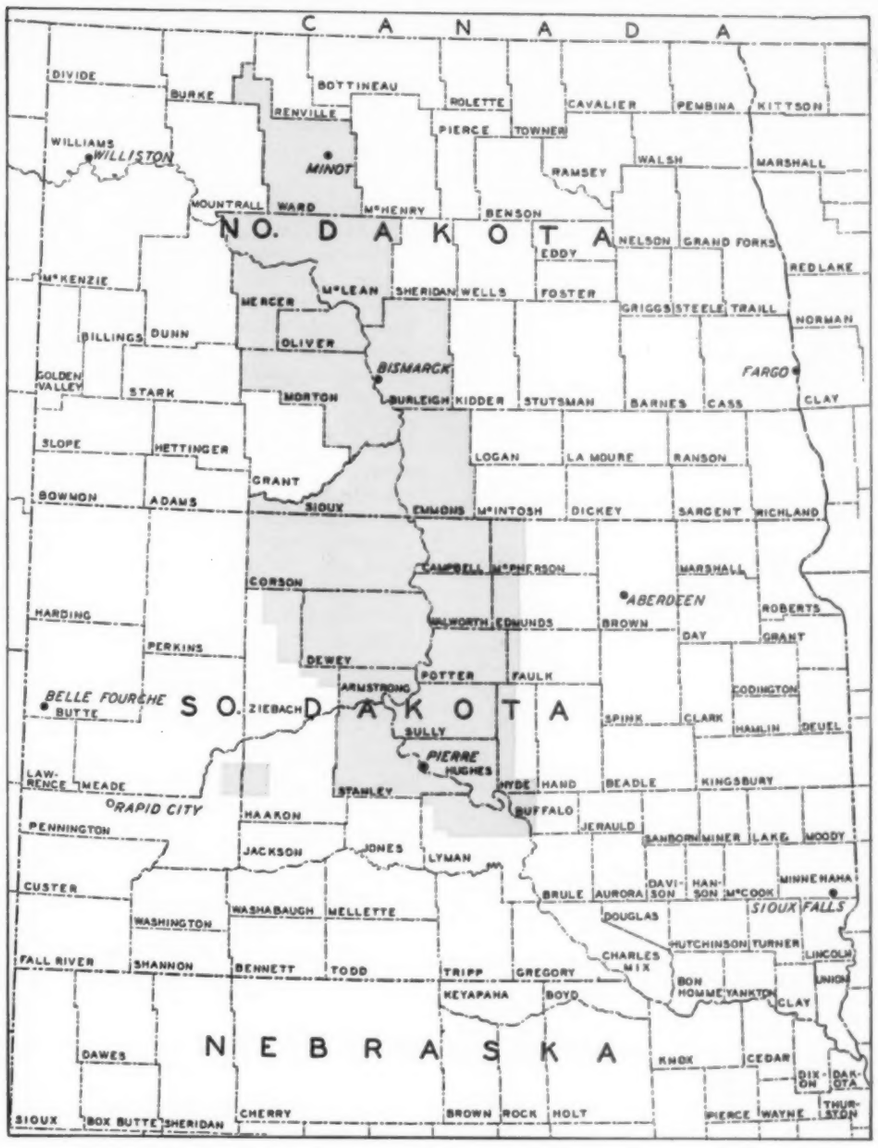
The act provides that the Industrial Commission shall obtain the assistance of the state geologist, who shall act as a supervisor charged with the duty of enforcement of the commission's orders.

In defining waste, the act interpreted the term to include:

(1) Underground waste and the inefficient, excessive, or improper use or dissipation of reservoir energy, including gas energy and water drive, of any pool; and the locating, spacing, drilling, equipping, operating, or producing of any oil well or gas well . . . to reduce the ultimate recoverable oil from the pool; and

(2) Surface waste and the inefficient storing of oil, and the locating, spacing, drilling, equipping, operating or producing of oil or gas wells so as to cause unnecessary surface loss or destruction of oil or gas.

Operators are required to file with the Industrial Commission for a drilling permit for each well, the fee being set at $25 per well, no operations being allowed until drilling notice is offered and the fee paid. Another provision compels the filing of logs, including electrical surveys, drilling records, and cores, within six months from the date of completion of any well. It requires the operation of wells with efficient gas-oil ratios, and fixes such ratios. Shooting and acid treatment are to be regulated. Power is conveyed to the commission to regulate secondary recovery methods, including the injection of air, gas, or water into the producing formations. The commission is granted express authority to regulate the spacing of wells. All companies are required to file with the state geologist notice of intention to drill stratigraphic test wells, setting forth the location, and to file a plugging report within sixty days after completion of such wells.



Map of North and South Dakota with areas of leasing activity indicated in yellow.

The act provides that intentional violators of the provisions thereof shall be guilty of a misdemeanor, and shall be subject, upon conviction, to a fine of not more than $500 or imprisonment in the county jail for a term not to exceed six months, or both such fine and imprisonment.

Senate Bill No. 134, passed and approved on March 7th, becomes effective July 1st. It authorizes the leasing of land owned by school districts, cities, villages, townships and park districts, for oil and gas; authorizing the governing boards to make such leases; providing for the consolidation of such oil and gas leases with adjoining lands for operation and development; and repealing all laws and parts of laws in conflict herewith.

The primary term of oil and gas leases covering school lands is limited to ten years. The act prohibits the drilling of any oil or gas well within 100 ft. of any public building upon any such land. All lease monies or royalty income become, under the act, a part of general funds of the particular school, city, village, township or park district.

The Committee on Judiciary also introduced Senate Bill No. 140 which authorizes the sale by executors, administrators, and guardians of estate of oil, gas and mineral interests in land, providing for the procedure relative to such sales.

Senate Bill No. 136, also introduced by the Committee on Judiciary, "legalizes the execution and acknowledgement of certain deeds, mortgages and other instruments in writing, and the record thereof, and the making the same of certified copies thereof, admissible in evidence." The measure was approved on March 7.

A New Method of Testing the Knocking Qualities of Motor Fuels

Automotive Engineers May Now Make Their Designs Conform to Lower Rather than Higher Octane Fuels, thus Turning the "Octane Race" in the Opposite Direction, According to a Report, Here Abridged in Translation, Published in Oel und Kohle.

THE importance of an engine test for determining the octane number and the anti-knock quality of gasolines is now generally recognized. An immense amount of thought and effort has been bestowed on the development of this test, both by the automobile builders and the petroleum specialists, and especially the refinery technologists on whom rests the responsibility of providing acceptable automotive fuels.

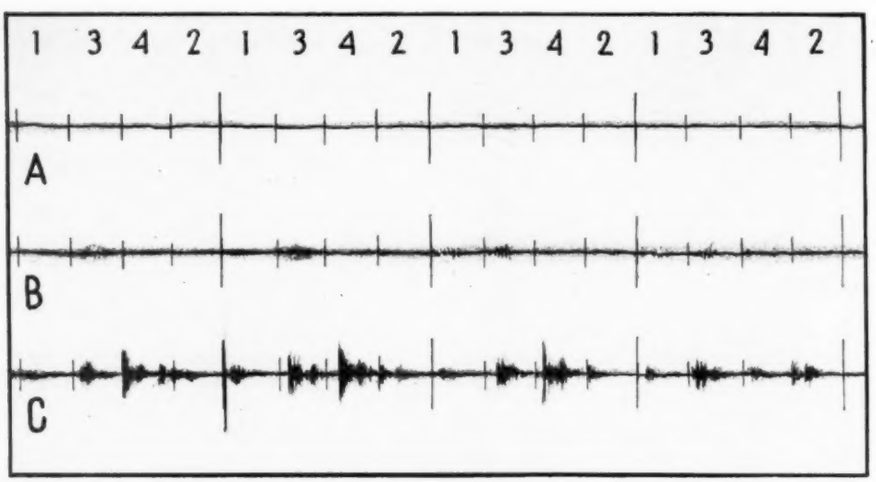
Efforts to perfect the engine test have been along two principal lines. One of these lines has become materialized in the well known C. F. R. method, by which it is sought to evaluate automotive fuels in a one-cylinder engine having specified dimensions and characteristics. But the hope of transferring the data obtained by means of this fixed type of one-cylinder engine directly to the multi-cylinder engines, now used in all automotive vehicles, has thus far been more or less illusory. A C. F. R. test on a series of fuels undoubtedly will rate them correctly as far as concerns the C. F. R. engine, but the ratings will not necessarily be the same in other engines, or in the same engine under different operating conditions.

In recognition of the limitations of the fixed one-cylinder engine, efforts have been made to develop a test that will be applicable to the multiple-cylinder engine. The first attempt in that direction seems to have been made with the German one-cylinder Vario-Opel engine, which comprised an arrangement through which the compression ratio could be altered during operation by means of an adjustable piston stroke. It does not appear that this device had any appreciable success.

In the United States the effort to use multiple-cylinder engines for evaluating fuels took the form of the road test, in which the vehicle with its engine is driven over country roads. But the results of these road tests are often very far from agreeing with the octane numbers derived from tests with the standard one-cylinder engine. In the effort to do away with this discrepancy between the road test and the laboratory bench test the C. F. R. method has undergone successive modifications and improvements; but while the approach to concordance has been considerable the discrepancy is still present, both as regards automobile and aviation fuels.

One very important objection that can be made to the octane number as now conceived and determined, is that the octane number, as a measure of the knocking of a fuel, takes in only a fraction of the time-range of the knock. As is now known, the knock does not occur instantaneously; there is first heard a faint, scarcely audible noise which, according to circumstances, swells in volume and becomes unmistakable. The octane number actually covers only a small section of this phenomenon, so that its position on the knock curve is more or less arbitrary, and is much influenced by the method of testing. If the method is altered, the same fuel may be given quite a different octane number. This is probably one of the reasons why it has not been possible to bring the results of the one-cylinder engine method into better harmony with the practical road test.

Fig. 1—Top line, engine driven from outside source; middle line, engine normally loaded under own power; bottom line, engine overloaded.



Such considerations have induced the author, with the support of the German Communications Ministry, the German Aviation Ministry and the Reichs Research Council to embark on an extensive research to visualize the engine knock throughout its entire extent. The curves representing the knock were to include not only the loud and the barely audible portions, but also the first beginnings that are not perceptible to the ear.

It seemed to be of especial importance to investigate the inaudible portion of the knock, as it might be associated with circumstances that are more or less responsible for wear of the engine.

For this investigation there was developed an electro-acoustic method, by which the noise was picked up and made visible in a Braun tube. This method has the advantage of being entirely objective; the noise can not only be seen, but may be permanently fixed in a photograph for later evaluation and comparison. It has the further advantage that no special engine is necessary, because the microphone can be attached directly to any type of engine and measurements made during normal road operation.

Originally the noises were transmitted through air, but it was soon found that transmission through a solid was much better, because in that case foreign noises could be more completely screened out.

Aside from the apparatus comprising the Braun tube, another apparatus was invented by which the intensity of the noise is registered by the needle of a dial so that it is practicable to construct and compare knock curves of a test gasoline and a standard reference fuel. A similar curve can also be constructed from the photographs.

In the development of the method it was of especial importance to exclude extraneous noises to the greatest possible extent, so that engines of different knocking characteristics could be tested side by side without mutual

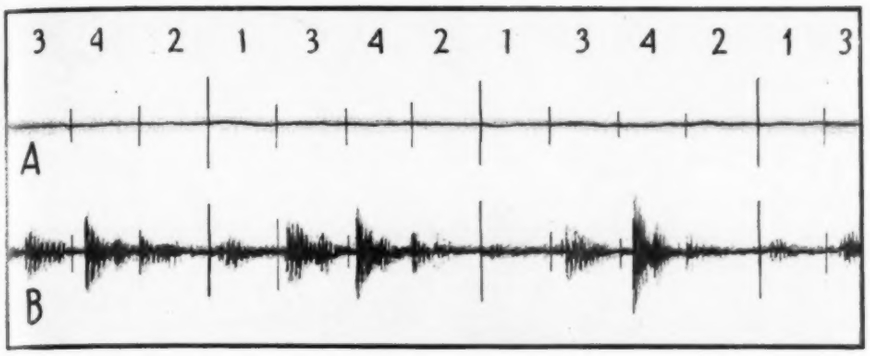


Fig. 2—Upper line, noise band of normally loaded 4-cylinder engine; bottom line, same cylinder overloaded.

interference. It was in this respect that transmission of the noise through a solid showed its great advantage over transmission through air.

By the use of appropriate sound screens it was found possible to consolidate all the incidental noises that attend the operation of every engine so that they would appear on the screen of the Braun tube as a practically uniform line. The sum of these incidental noises, which have no significance in knock measurements, is called the noise band. When reduced to this form the general noises have no disturbing effect, and allow the true knock phenomena to show forth very clearly.

These relations are shown in the accompanying Figure 1. At the top, *a*, is shown the scarcely perceptible noise band of the engine, when it is driven by power from an outside source; at *b* is the noise band of the engine normally operating under its own power; and at *c* the record of the same engine that has been overloaded to the point where some of the cylinders are knocking. Even the noise of the unmuffled exhaust is effectively screened out.

The chief result of the investigation is undoubtedly the demonstration that by the use of this electro-acoustic method it is possible to show the behavior of each cylinder of the engine on the same picture, which opens the way to obtain important information and comparisons. In this work with multi-cylinder engines it is advisable to screen out the noise of the spark plugs, which might otherwise appear too prominently on the noise band. If one cylinder is left unscreened, a marker is obtained by which the positions of the cylinders on the picture can be ascertained. The number of cylinders is immaterial whether four, six, or eight. Figure 2 shows at *a* the noise band of a four-cylinder engine operating under a normal load; *b* is the record of the same engine when overloaded; in this condition the second and fourth cylinders are knocking vigorously while cylinders one and three are practically knock-free. This ability to study each individual cylinder of a multi-cylinder engine separately from the others should soon prove an invaluable aid in determining the relation between engine construction and fuel quality.

Incidentally, it is to be emphasized on all occasions that the ultimate aim both of automotive fuel manufacturers and the builders of automotive engines should be to work for an optimum relation between fuel and engine, and to bestow on neither member of this pair a quality which is out of line with the quality of the other. For instance, it is a mistaken policy to produce a motor fuel of excessively high quality[1]. Such insistence on high quality (octane number) is disadvantageous to countries (like most European countries) that are poor in oil resources, for two reasons. One is the extra drain on foreign exchange to pay for high quality imports, and the other is a narrowing of the field of usefulness of the native natural and synthetic oil products, which are limited both as to quantity and quality. Instead of the fuel producers making every effort to furnish more octanes, it should be the object of the engine builders to create engines that are less prone to knock and need fewer octanes.

These considerations have forced the German automotive industry and the German Army Ordnance Department jointly to seek an answer to the following two questions:

(a) To what octane number can automotive engines be adjusted so that engine efficiency shall not be unduly depressed?

(b) At what octane number can the present source of supply furnish the maximum amount of usable light motor fuel?

Work on these questions has led to official selection of the octane number 74 as best equating resources with requirements. Since under the prevailing circumstances it is on the whole easier to adjust the construction of the engines than to change the total quantity and quality of German automotive fuel, the petroleum industry has only to standardize on 74 octane number and leave it to the engine builders to govern themselves accordingly.[2]

The question arises, is the standard of 74 octane number subject to modification, and in particular, whether this number can be reduced, thus opening the way to a more extended use of lower qualities and quantities of automotive fuel?

The author has as yet no ready answer to that question, but it appears to be clear that the electro-acoustic method of investigating knock affords a means of obtaining conclusive answers. Since every cylinder of any multi-cylinder engine can now be made to give an account of itself under actual operating conditions on the road, it should be possible to determine whether small constructional changes in engine design will allow the octane number of the fuel to be reduced, the eventual goal being to produce an engine that will in fact be knock-free when using fuels now regarded as of inferior quality.

In preparations for this important line of research the work of several years has at length crystallized in the construction and demonstration of a portable apparatus that without difficulty can be used on any type of automobile. The general appearance of the new knock-measuring instrument is indicated in the accompanying illustration (Figure 3) whereon *m* indicates the microphone, *v* the amplifier with noise screen and resonance connection and *o* the oscillograph. The thyraton tube of the oscillograph is controlled by an impulse that is dependent on the number of revolutions of the engine, so that when the car is driven on the road at a constant speed the image is constant, and can be registered by a simple photograph on a sensitive film. Several types of microphone were employed in this work; the one that gives the best results is a crystal microphone; the condenser microphone and electro-magnetic microphones, with either air or solid transmission of the vibrations, are relatively unsuitable. The method of mounting the apparatus in the car is shown in Figure 4, where *A* shows the microphone attached to the engine, *B* the measuring apparatus, and *C* a source of electric current. The best place to attach the microphone is determined by a few preliminary trials.

With the apparatus as here described

Fig. 3.—The knock-measuring instrument.

[1] It must be remembered that the author is discussing this subject in relation to conditions existing in Germany.—Editor.

[2] According to press reports even the German military airplane engines are operating efficiently on 74 octane number gasoline.—Editor.

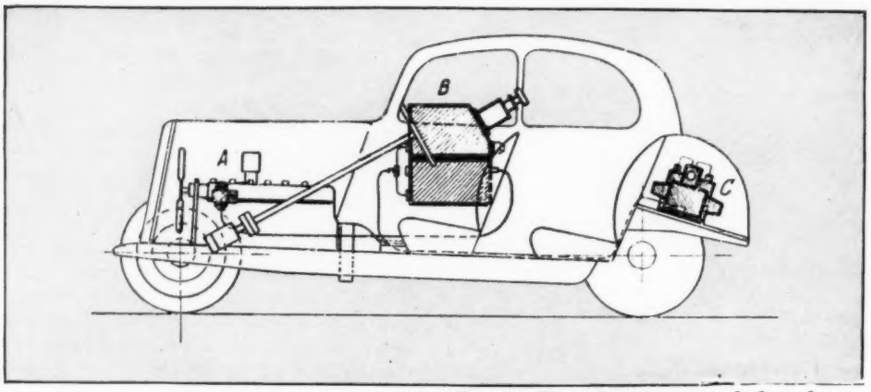


Fig. 4.—The microphone attached to the car.

extensive road tests were made with different types of cars and engines, on country roads and on the *Reichsautobahn*, on the level and uphill. Knocking conditions were created by using a low octane number (66) Rumanian gasoline, by advancing the spark and by driving at high speeds. In these tests the apparatus demonstrated its ability to supply records of engine and fuel performance that could be readily interpreted.

The chief results of these road tests was to confirm the observation made while the investigation was still in the laboratory stage, namely, that only in rare cases do all cylinders of a multi-cylinder engine knock simultaneously; in the great majority of cases only one or a few cylinders are responsible for the knocking phenomena, and in those cylinders that are knocking the knocks may be of different intensities.

The chief usefulness of the method lies in this ability to distinguish those cylinders that are knocking from those that are not knocking. This opens to the engine builder the possibility of identifying those features of design and construction which produce knock, so that these features can be corrected or eliminated and so that eventually there will be no knock in any cylinder even with a low-quality fuel. By following out this line the petroleum industry will be relieved of the necessity of striving for more and more octanes to be sold to the consumer at a premium. On the contrary, the efforts of the petroleum technologists will be turned in the opposite direction, namely, to supply motor fuel of the lowest octane number that will meet requirements, leaving the engine builders with the responsibility of adjusting their product to the low-octane fuel.

The circumstances that produce knock in one cylinder while others are knock-free under the same road and fuel conditions are of different orders and are not yet fully known. Among those that are known or suspected are unequal or insufficient dissipation of heat (non-uniform cooling), constructive inequalities in compression, irregularities in spark adjustment, and in particular irregularities in air-gas ratio or insufficient mixing of air and vaporized fuel. These are defects which the engine builders now have an opportunity to study and remove.

Van der Woude Reviews Industry's Position

ADDRESSING the annual meeting of stockholders of Shell Union Oil Company held in New York April 17, R. G. A. van der Woude, president of the company, summarized the position of the oil industry in relation to national defense and to other industries in some pertinent remarks from which the following is extracted:

"Since the close of the year general industrial activity has continued to expand and there has been a substantial increase in demand for petroleum products. This is attributable to a considerable degree to the progress in the national defense program the importance of which in the furtherance of the nation's preparedness requires no emphasis. The oil industry realizes this fully and was prepared to meet increased requirements of petroleum products on the part of the Army and Navy and of industry at large long before the need became generally apparent. The oil industry stands ready to meet all demands for direct and indirect defense purposes without curtailment of civilian consumption. This it is able and anxious to with its own resources without resorting to government financial support.

"In appraising the position of the oil industry in the national economy, it is interesting to observe that prices of petroleum products compare most favorably with other commodities.

"Using 1926 as a base with Index 100, (exclusive of taxes), the U. S. Bureau of Labor Statistics index of all commodities is currently 82, whereas the petroleum index is but 51, indicating that the wholesale price level for all commodities is 60 per cent above that for petroleum and its products. It is particularly noteworthy that prices of petroleum products have continued to decline although quality has been greatly improved over the past fifteen years.

"Should one consider prices for the five-year period (1934 through 1938) preceding the war as Index 100, the wholesale price level for all commodities is currently 102.6, while that of petroleum and its products is 92.4, thus further illustrating that petroleum prices have continued to decline in the face of a steadily rising price level in the national economy.

"The task of solving the problems confronting the oil industry and meeting prospective requirements has not been facilitated by the various antitrust suits to which the industry has been subjected. Cooperation in its true sense is of primary importance for the successful fulfillment of the national defense program. This means cooperation between industry and government on the one hand and between industry and labor on the other. In this direction lies the way to a better understanding of each other's difficulties, and this understanding is absolutely vital at the present moment when the nation is faced with critical issues of tremendous import.

"We are living in times of great change; some find it easier to adjust their views than others. But the essential appears to be cooperation of all elements: industry and government must work more closely than has been the case in the past, and it is hoped that from this will emerge a better understanding of each other's problems.

"Closer cooperation and good-will between different industries are also essential. The oil industry, through its many activities from oil well to consumer, has contact with almost every other industry. For example, the railroads derive a large income from the oil industry, and yet we have for some time observed certain activities by the railroads to create difficulties for the oil industry in its endeavors to develop the most economical means of transportation. This has been particularly evident recently in connection with the proposed construction of pipe lines in the southeast, notwithstanding the fact that these lines under present conditions would be an important contribution to the national defense since they would greatly relieve ocean transportation and assist the already difficult tanker situation.

"The results for the first quarter of this year have been somewhat less favorable than for the similar period of last year. The trend this year promises to reverse that of last year, when the most favorable results were achieved in the early part of the year. It is anticipated that for the second quarter of this year the results should be somewhat better than for the first quarter with indications that favorable conditions will carry through for the balance of the year. It is difficult, however, to make predictions at this time for the latter half of the year in view of the uncertainties as to general conditions, prices, taxation, and other factors affecting the situation."

WORLD OIL PRODUCTION

Figures in U. S. barrels of 42 gal.—Conversion ratios used are weighted averages for individual countries.

U. S. BARRELS — METRIC TONS

	Mar. 1941 Preliminary	Mar. 1940	Jan.-Mar. 1941	Jan.-Mar. 1940	Mar. 1941 Preliminary	Mar. 1940	Jan.-Mar. 1941	Jan.-Mar. 1940
United States	110,391,000	120,075,000	321,830,900	341,884,500	14,935,867	16,246,164	43,543,619	46,256,919
Soviet Union	19,000,000	18,454,796	56,900,000	54,113,451	2,606,310	2,531,522	7,805,212	7,399,740
Venezuela	16,096,650	15,514,962	46,277,384	44,693,763	2,390,000	2,303,632	6,871,176	6,636,045
Iran	6,560,000	6,745,073	19,120,000	19,610,471	870,000	894,753	2,535,926	2,601,398
Netherland India: Sumatra	3,350,000	3,440,792	9,995,000	10,063,114	428,882	440,506	1,290,465	1,288,326
Borneo	1,100,000	1,097,516	3,170,400	3,253,469	140,827	140,509	405,851	416,524
Java	550,000	562,665	1,587,600	1,630,936	70,413	72,035	203,625	208,800
Molucca and Other	60,500	54,021	178,800	175,576	7,745	6,916	22,998	22,478
Rumania	3,100,000	3,818,554	8,089,306	11,201,350	375,000	517,770	1,096,855	1,518,827
Mexico	2,976,000	3,286,000	8,971,000	9,782,067	437,004	482,525	1,317,326	1,436,790
Iraq	1,000,000	2,666,713	2,950,000	7,743,565	133,672	356,531	394,332	1,036,121
Colombia	1,500,000	2,203,272	5,037,000	6,706,890	209,205	307,290	702,510	935,408
Trinidad	1,750,000	1,633,421	5,250,000	4,799,674	246,132	229,710	738,397	675,067
Argentine	1,795,000	1,682,029	5,366,000	4,888,867	255,698	239,605	764,387	696,419
Peru	1,000,000	1,139,932	2,975,000	3,365,838	132,013	150,784	392,738	445,331
Bahrein	635,000	636,577	1,825,000	1,849,476	86,653	87,017	249,043	252,531
Burma	657,600	689,750	1,955,200	1,985,599	90,500	94,147	269,397	273,103
Canada	750,000	570,131	2,290,730	1,712,576	95,444	72,554	291,080	217,940
Brunei	472,200	487,661	1,404,400	1,433,014	62,970	65,038	186,339	191,131
Great Germany: Old Reich	380,000	386,508	1,110,000	1,128,005	54,340	55,800	158,730	162,760
Ostmark	58,800	61,721	175,600	177,662	8,765	9,827	26,178	28,206
Slovakia and Moravia	9,800	10,106	28,600	29,697	1,470	1,519	4,266	4,459
Poland	320,700	331,669	941,400	972,873	43,000	44,516	126,436	130,552
Japan	217,470	224,068	634,940	660,177	31,000	32,023	90,449	94,332
British India	185,400	189,999	550,800	567,882	25,600	26,226	76,061	78,417
Ecuador	110,060	211,610	324,763	604,143	14,510	27,898	42,815	79,648
Saudi Arabia	467,900	606,201	1,401,800	1,421,280	63,400	82,120	189,943	192,536
Sarawak	108,000	112,282	317,720	329,949	13,370	14,415	39,740	42,497
Egypt	650,000	455,000	1,900,000	1,343,367	92,830	64,981	271,349	191,854
Italian Empire: Albania	135,000	123,411	400,000	353,999	20,233	18,415	59,950	52,847
Italy	4,000	5,500	11,900	18,150	500	680	1,484	2,250
France	40,000	42,439	115,000	124,788	5,610	5,952	16,129	17,472
Hungary	180,000	110,000	530,000	300,000	24,200	14,800	71,270	40,350
Bolivia	10,000	8,587	29,500	25,118	1,400	992	4,031	2,912
Other Countries	47,800	49,786	143,400	144,708	6,800	7,006	20,400	20,506
WORLD TOTAL	175,668,880	187,687,752	513,789,143	539,096,194	23,981,363	25,646,178	70,280,509	73,650,496

Official Crude Oil Production Figures for 1938 to 1940

Daily Averages

	Bbl.		Metric Tons		Bbl.			Metric Tons		
	Jan.-Mar. 1941	Jan.-Mar. 1940	Jan.-Mar. 1941	Jan.-Mar. 1940	1940	1939	1938	1940	1939	1938
United States	3,575,898	3,756,972	483,817	508,317	1,351,849,500	1,264,962,000	1,214,355,000	182,904,869	171,152,192	164,346,325
Soviet Union	632,222	594,653	86,724	81,315	216,909,066	216,727,024	206,192,000	29,702,277	29,530,168	28,859,000
Venezuela	514,193	491,140	76,346	72,923	184,761,241	205,783,650	188,429,050	27,432,998	30,533,706	27,845,286
Iran	212,444	215,499	28,177	28,589	79,151,675	78,151,332	78,320,840	10,443,546	10,367,117	10,358,495
Netherland India: Sumatra	111,055	110,583	14,338	14,157	40,586,986	41,557,013	34,538,128	5,172,209	5,320,320	4,662,836
Borneo	35,226	35,752	4,509	4,577	12,987,599	13,125,425	12,812,383	1,662,718	1,680,377	1,719,783
Java	17,640	17,922	2,262	2,294	6,523,462	6,568,714	6,955,283	836,982	842,237	933,595
Molucca and Other	1,986	1,929	255	247	731,746	836,144	607,622	93,569	107,047	81,560
Rumania	89,881	123,092	12,187	16,690	42,885,625	46,020,000	48,366,000	5,815,000	6,240,000	6,603,000
Mexico	98,566	107,495	14,637	15,789	40,000,000	39,428,141	38,505,824	5,873,715	5,794,035	5,716,423
Iraq	327,777	85,094	4,381	11,386	24,225,007	30,791,132	32,404,000	3,238,878	4,115,845	4,345,000
Colombia	55,966	73,702	7,805	10,279	25,592,890	22,036,613	21,581,588	3,569,434	3,067,568	3,007,935
Trinidad	58,333	52,745	8,204	7,418	20,218,568	19,270,256	17,736,176	2,842,918	2,710,515	2,472,943
Argentine	59,622	53,723	8,493	7,653	20,609,160	18,738,003	17,076,237	2,935,777	2,657,232	2,432,857
Peru	33,055	36,987	4,363	4,893	12,985,284	13,587,906	15,908,279	1,716,195	1,798,557	9,099,885
Bahrein	20,055	20,323	2,767	2,775	7,096,141	7,588,554	8,297,998	968,502	1,045,391	1,130,734
Burma	21,724	21,819	2,993	3,001	7,978,969	7,872,981	7,499,498	1,098,184	1,087,424	1,039,960
Canada	25,452	18,819	3,234	2,395	8,718,053	7,837,503	6,965,457	1,109,440	997,487	879,921
Brunei	15,604	15,747	2,070	2,100	5,729,374	5,767,227	5,387,214	764,006	768,320	707,123
Great Germany: Old Reich	12,333	12,395	1,763	1,788	4,543,954	4,487,491	3,850,044	653,590	647,337	552,074
Ostmark	1,951	1,952	290	309	718,494	693,247	370,038	114,045	109,904	63,468
Slovakia and Moravia	318	326	47	49	118,775	119,380	132,005	17,836	18,103	19,282
Poland	10,460	10,690	1,404	1,434	3,891,456	3,898,044	3,828,438	521,984	522,874	504,678
Japan	7,055	7,254	1,005	1,036	2,638,644	2,652,930	2,511,184	376,657	379,161	356,328
British India	6,120	6,240	845	861	2,249,835	2,332,467	2,330,209	310,596	322,160	322,125
Ecuador	3,608	6,638	475	875	2,349,015	2,312,118	2,257,278	309,686	306,824	319,877
Saudi Arabia	15,575	15,618	2,110	2,115	5,364,610	3,933,904	495,135	726,785	536,366	66,683
Sarawak	3,530	3,625	441	467	1,317,185	1,329,645	1,624,882	168,475	171,322	200,126
Egypt	21,111	14,762	3,015	2,108	6,053,367	4,603,797	1,561,231	864,514	657,570	223,058
Italian Empire: Albania	4,444	3,890	666	580	1,497,124	1,393,727	437,597	224,199	208,279	65,313
Italy	132	199	16	24	57,350	91,330	106,083	7,110	11,346	13,178
France	1,277	1,371	179	192	496,420	560,815	516,240	69,578	70,478	72,106
Hungary	5,888	3,296	792	443	1,755,000	815,248	330,829	236,025	109,896	42,798
Bolivia	328	276	44	32	110,484	100,885	106,620	14,249	11,998	13,262
Other Countries	1,593	1,590	226	225	579,997	578,036	243,000	82,779	82,300	34,080
WORLD TOTAL	5,708,768	5,924,134	780,894	809,346	2,142,382,016	2,076,492,682	1,982,639,390	292,879,325	283,981,456	279,111,097

Detailed monthly reports were published in February, 1941 issue.

Foreign Oil Legion

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Left to right, Howard Book, Mrs. Book, H. G. Hamaker, sales manager of Reed Roller Bit Company, Mrs. Mario Cueto and Mario Cueto. Mr. & Mrs. Book and Mr. & Mrs. Cueto sailed for Argentina from New York on April 26. Mr. Book, who is the export representative of Reed Roller Bit Company, expects to be gone about six months. He has previously acted as sales manager for the company in London, Canada and South America. Mr. Cueto, formerly petroleum engineer with the Y. P. F., has completed a course of training here and will represent Reed in Argentina.

Alfred Myer, president, Caracas Petroleum Company sailed from New York aboard the SS. SANTA ROSA on April 19 for a business trip to Venezuela.

Mr. & Mrs. Phillip Reed of the Richmond Petroleum Company as they sailed from New York April 21 aboard the SS. Jamaica for an indefinite stay at Barranquilla, Columbia.

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A meeting of the special commission designated by the executive council of the Union Sudamericana de Asociaciones de Ingenieros (USAI) was held recently in the club house of the Centro Argentino de Ingenieros at Buenos Aires for the purpose of drawing up the provisional statutes of the South American Petroleum Institute. The purposes of this Institute were outlined in the September 1940 issue of World Petroleum as it was proposed originally by Eng. C. P. Vegh Garzon. Plans for the Institute were recently voted by the Convention of South American Engineers which met at Lima, Peru. The committee which met in Buenos Aires consisted of Augustin Maggi, Uruguay; Juan Pinilla, Bolivia; C. R. Vegh Garzon, Uruguay; and Enrigue P. Canepa and Luis V. Migone, Argentina.

John P. Klep has been appointed manager of the Fort Worth office of Sperry-Sun Well Surveying Company to handle business in North Texas and Southern Oklahoma. Mr. Klep has been with the company since 1937. W. F. Krueger has been placed in charge of the Oklahoma office and will cover Oklahoma and Kansas. L. H. Creasy will cover West Texas for Sperry-Sun with headquarters at Lubbock, Texas.

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Mr. & Mrs. William Woodson of The Texas Company photographed in New York harbor as they sailed on the SS. Santa Rosa for South America for an indefinite stay.

The regular monthly dinner meeting of the Los Angeles chapter of the Nomads was held on April 9 and was featured by a short address in Spanish by Juan A. Castro of the Yacimiento Petroliferos Fiscales, Buenos Aires. Brief addresses in foreign languages will be a regular feature of subsequent meetings and are designed to stimulate interest on the part of Nomads in learning languages of the countries in which they expect to travel. Roy Kempley described his experiences hunting in Alaska where he and his wife spent six months in the Rainy Pass region west of Mt. McKinley hunting moose, caribou, bear and wolves. Mr. Kempley had some excellent moving pictures of his trip.

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Major C. N. Russell of Socony-Vacuum Oil Company with Mrs. Russell aboard the SS. Uruguay in New York harbor just before sailing for a three weeks business trip to Barbados.

A. C. Galbraith.

A. C. Galbraith, vice president, Union Oil Company, recently resigned his post with the company to enter private practice as a consultant in personnel management. Mr. Galbraith started work for Union in 1916 as a traveling auditor, later became manager of advertising and finally vice president. Much of Mr. Galbraith's work was in connection with personnel relations within the company.

Brig. General Isais Medina Angarita, Minister of War & Marine in Venezuela, was elected by the combined houses of Congress as president of the country to succeed Eleazar Lopez Contreras. Gen. Medina, 43 years old, was elected on April 28.

T. G. Martin, field engineer of Los Angeles, California, left early in April for an extended business trip through South America in the interests of the companies represented by R. J. Eiche.

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Wolfgang Greeven, assistant to the manager of the West India Oil Company (SONJ) in Chile with Mrs. Greeven and their two sons, John Michael (left) and Paul Patrick. Mr. Greeven and his family arrived in New York Monday morning, April 21, aboard the SS. Santa Elena for a three or four months vacation in the United States.

The New York Chapter of the Nomads held their third meeting of 1941 on Monday, April 7. The attendance was the largest in the history of the organization; 68 members and their guests listened to an interesting address

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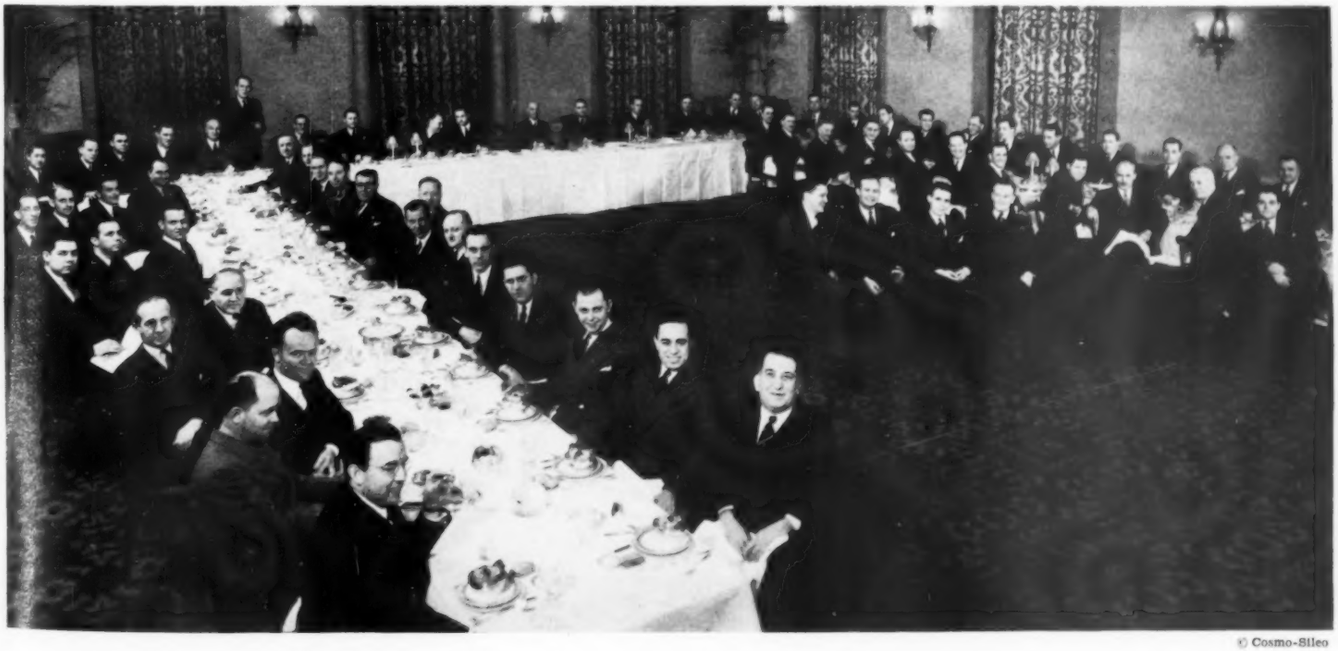
Dr. Waldo Stevens.

on present day world affairs outlining some of the factors that let up to today's world strife. This address was given by Dr. Waldo Stephens who was for some years professor of Foreign Affairs at Columbia University. Dr. Stephens was well qualified to discuss this interesting subject, as he had served as unofficial observer at Geneva of the proceedings of the League of Nations for several years. During his address at the Nomads meeting, Dr. Stephens emphasized the need for active assistance for the British from the democracies and from oil men in particular. He is now associated with his brothers in the management of the Ray B. Stephens Company, oil producers, with headquarters in Tulsa. Following the address by Dr. Stephens, a varied program of entertainment was held.

New York chapter of the Nomads having dinner in New York at the monthly meeting on April 7 when they heard an address by Dr. Waldo Stephens, pictured above.



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WORLD PETROLEUM ABSTRACTS

Summaries of the Most Important Articles as Published in the Oil Press of the World Dealing with Technical and Economic Aspects of the Petroleum Industry — Edited by Dr. O. W. Willcox.

GEOPHYSICS

The Gulf Underwater Gravimeter—T. B. Pepper, in GEOPHYSICS, vol. 6 (1941), No. 1, pp. 33-44.

The extension of oil prospecting to areas covered by water has created a necessity for conferring on the gravimeter, heretofore a strictly dry land instrument, more of an amphibious character.

A brief description of the Gulf underwater gravimeter is presented showing the salient design features whereby a regular Gulf gravimeter is incorporated in a device permitting precision gravity measurements in coastal waters several hundred feet in depth.

The instrument is adapted to be lowered to the bottom on a cable and through remote control devices all necessary adjustments are made from the surface. The reading is obtained photographically on a continuously moving film which permits accurate observations even when moderate seismic disturbances cause oscillation of the index point.

Chemistry in Exploration for Petroleum—Leo Horvitz before Division of Petroleum Chemistry, AMERICAN CHEMICAL SOCIETY, St. Louis Meeting, April, 1941.

This paper describes the application of chemical methods to exploration for petroleum. The techniques developed are referred to as geochemical prospecting methods.

Two separate techniques are described. The first involves the analysis of samples of soil or soil air, collected near the surface of the earth, for the purpose of outlining the areal extent of a buried oil or gas accumulation. The second involves the analysis of cuttings and cores, collected during the drilling of a well, for the purpose of determining, in advance of the drill, the probability of encountering an accumulation.

The analytical technique is described in detail and several examples of geochemical surveys are included. Several typical geochemical well logs are also shown.

A New Geochemical Prospecting Method for Oil and Gas. The Geodynamic Process—Sylvian J. Pirson, before Petroleum Division, AMERICAN INSTITUTE MINING METALLURGICAL ENGINEERS, New York meeting, February, 1941.

The author proposes what he calls a geodynamic method of prospecting for oil and gas fields. The method is based on the assumption that the lightest hydrocarbons, particularly ethane, will diffuse upward through the strata overlying the buried oil or gas pool, and that the quantity of this diffusing gas will be greatest in the soil vertically above the axis of the source.

The practical application of the method in outline is as follows: A shallow bore-hold of a measured volume is made in the soil, and sealed in such a way that the pressure of the gas that is endeavoring to escape may be measured at intervals of time. The rate at which the pressure is built up is taken as a measure of the concentration of the gas, or rate of leakage from the pool. Where this leakage is the greatest will be the most likely place to put down a wildcat well.

GEOLOGY

The Edna Gas Field (Jackson Co., Texas)—M. M. Kornfeld and C. R. Steinberger, in BULLETIN AMERICAN SOCIETY PETROLEUM GEOLOGISTS, vol. 25 (1941), No. 1, pp. 104-119.

In common with many of the older fields of the Gulf Coast region, outside the definitely established productive trends as now known, the Edna gas field had only a limited amount of scientific development. The records of early wells are inadequate for present use but point to the possibility of a productive area greatly in excess of the present producing limits. It is believed that careful and extensive coring supported by electrical well logging will add a number of producing gas sands to the field and it is possible that oil sands will be uncovered in the section now considered to be solely gas-bearing. Improved completion methods and restricted flowing rates for the gas wells should lengthen the life of the individual wells considerably over that of the old wells which were subjected to heavy unrestricted withdrawals.

Of the 25 tests and 15 producers that have been drilled to date, five are now producing, all from the "Frio" between 4,600 and 5,000 feet. The deepest test penetrated the lower Jackson to 7,170 feet.

Tectonic Provinces of Southern Oklahoma and Their Relation to Oil and Gas Fields—E. A. Paschal, in BULLETIN AMERICAN ASSOCIATION PETROLEUM GEOLOGISTS, VOL. 25 (1941), No. 1, pp. 1-22.

Southern Oklahoma and adjoining areas are divided into five tectonic provinces. One is considered a part of the Appalachian-Ouachita-Marathon homogeneous mobile belt which extends across the continent. The other four are considered as having the features of a heterogeneous mobile belt. They are treated as two "uplifts" and two "geosynclines" and are compared with similar provinces in California.

Evidence is presented to show that one of the geosynclines has been compressed or squeezed between the two adjoining uplifts since the deposition of the Pernian redbeds. The local structures within the geosynclines are considered as have been formed primarily by compression, whereas the local structures on the uplifts are considered as having been formed by "vertical uplift". The local structures on the two uplift provinces are considered as having possibilities of more prolific oil production, especially from Ordovician beds, than the local structures within the geosynclines.

Although the Ordovician beds are known to lie at depths of 10,000 feet or more, in the most promising parts of the undeveloped area, it is believed that fields producing therefrom will prove profitable especially where thick bodies of "Wilcox" sand are found.

DRILLING

Fineness and Water-Cement Ratio in Relation to Volume and Permeability of Cement—J. R. Colman and G. L. Corrigan, in PETROLEUM TECHNOLOGY, Technical Publication No. 1266, January, 1941.

The authors have made a contribution to the knowledge of oil-well cements. In the first place, they prove that the volume of the cement (after it has solidified) depends on the amount of water used in making the slurry and on the degree of fineness of the cement. By using the finest cement (1890 sq. cm. per gram) and a water-cement ratio of 70 percent, the solified cement will have 95 per cent of the volume of the slurry, and by lowering the water-cement ratio to 40 or 50 percent the set volume is very close to 100 percent. On the other hand, with coarser cements the set volume may be as low as 77.6 percent. This is important in determining how much slurry to make. A graph shows how the proportions may be calculated.

Another fact that is emphasized is that cement mixed at high cement-water ratios may show greater permeability toward the top, due to a tendency of much cement to settle out of thin slurries. On the other hand, with fine cements and low water ratios there is a decrease of permeability.

Horizontally Drilled Wells—Leo Ranney, before AMERICAN INSTITUTE MINING METALLURGICAL ENGINEERS, Low Angeles, January, 1941

A vertical concrete lined shaft was sunk to a shallow oil sand. An enclosed tank was lowered to the bottom of the shaft to serve as a sump, and above the tank was constructed a working floor. From this floor radial horizontal holes were cored out into the oil sand for distances up to 1,000 feet. The method of drilling was such that no drilling time is lost in round trips; while the tools are being withdrawn from one hole, the same motion is used to make hole on the diametrically opposite side. The drilling mechanism was operated by a specially built diamond drilling machine installed on the floor in the center of the working chamber.

It is said that the direction of the horizontal drill holes can be very accurately controlled, and that the direction can be changed up, down or sideways without the use of a whipstock.

The sand thus perforated had a saturation of less than 15 percent, and the laboratory experts who analyzed the cores reported that because of this low saturation no oil would flow. But after shooting, the daily recovery of oil was at a rate greater than the combined yield of 50 vertical wells in the vicinity (actual figures are not given).

In discussing his results the author considers that the advantage of this horizontal piercing of

an oil sand exposes a vastly greater drainage surface than a vertical well, which may penetrate fifty feet or so into the sand. Since it appears that horizontal holes may be surveyed and controlled at a length of 1,000 feet as easily as at 100 feet there appears to be no reason why such holes may not be drilled 3,500 feet long, so that 800 acres of ground might be worked from one shaft.

The author also takes occasion to mention an interesting use of horizontal holes in gas production. This is the degassing of coal seams by horizontally drilled holes in advance of mining operations to remove the coal, the object being to obviate the danger of gas explosions. From a coal mine in Ohio it is said that from one opening there is daily available 2,000,000 cubic feet of gas which can be sold at a profit. It is pointed out that many hundred thousand of acres of coal in Pennsylvania, West Virginia and Ohio contain up to 22 million cubic feet of absorbed gas per acre.

Control of Filtration Characteristics of Salt-Water Muds—G. R. Gray, J. L. Foster and T. S. Chapman, before Petroleum Division, AMERICAN INSTITUTE MINING METALLURGICAL ENGINEERS, New York meeting, February, 1941.

Where drilling mud loses water by filtration into the surrounding formation the wall of the hole acquires a layer of mud material which is the thicker the larger the quantity of water that has filtered away. The thickness of this coating may have disagreeable consequences, such as stuck drill pipe and difficulty in running casing.

Various means have been used to make it more difficult for the drilling fluid to lose water in this way. Experience with some 80 wells in West Texas has shown the usefulness of certain natural gums or gelatinized starch. Natural gums, such as tragacanth, arabic, ghatti, karaya and locust bean have been found effective, but both their cost and supply under present conditions make them not very attractive.

Starch, on the other hand, is readily available from a number of domestic sources. The authors proceed as follows:

Starch is gelatinized or pasted by the addition of caustic soda. A practical suspension for addition to drilling mud contains 10 per cent by weight of starch and 1 per cent of caustic soda. In a field test 4,000 lb. of starch were added after several hundred feet of salt had been penetrated and water loss increased from 30 to 82 cc. in 30 minutes. As a result filtration was reduced to 22 cc. in 30 minutes and further additions brought average water loss down to 15 cc. in 30 minutes during completion of the hole. No trouble was encountered setting casing. A commercial clay showed loss of 92 cc. in 30 minutes.

The authors use their West Texas experience as a basis for recommending the use of gums or gelatinized starch as additions to drilling muds in salt-dome fields in the Gulf Coast.

The Characteristics and Application of an Oil-Base Mud—Horace W. Hindry, before PETROLEUM DIVISION A. I. M. E., Los Angeles, October, 1940.

An oil-base mud as a rotary drilling fluid in which oil has been substituted for water as the principal liquid component has been developed and used by Shell Oil Co. The type most in use at present is composed of stove oil as the liquid medium, oyster shells limestone or barytes as weighing materials and to provide the initial plastering, lamp-black for gel strength and structure, and blown asphalt to assist plastering. The amount of oil used is equal to or double the amount of blown asphalt. The lamp black component has a large effect on the mud viscosity and is most effective in decreasing filtration loss when used in the proportion of 2 percent; for some unexplained reason larger quantities of lamp-black seem to increase filtering loss.

The equipment for handling the oil-base mud is about the same as for an ordinary mud, although it is advisable to wash the mud screens with stove oil instead of with water. Small quantities of water do not affect the physical properties, but of course this oil fluid is inflammable and corresponding precautions must be taken. The drilling rates are said to be slower than with water-base muds and the drilling costs are generally somewhat higher. The chief advantage of the oil-base mud appears to be that it has very little tendency to gas-cut, and hence it is permissible to maintain higher viscosities to minimize settling when drilling is temporarily suspended. Other purposes are to:

Minimize the possibility of impairing the natural flow potentialities of the producing horizon such as that resulting from infiltration of water from water base muds;

Permit smaller clearances for settling liners since the mud sheath has no appreciable thickness;

Eliminate the possibility of clogging the perforations of the liner with thick mud sheath;

Facilitate the removal of the mud sheath from the walls of the hole, for its mud sheath has no appreciable strength;

Assist in drilling through formations, such as "heaving shale," where water wetting appears to be a source of difficulty.

Permit cores to be obtained without contamination from drilling water.

New Fast Setting Cement—R. K. Henderson, in REFINER, Vol. 11 (1940) No. 13, pp. 93-94.

The new cement is composed of 98 percent dehydrated calcium to which has been added materials for controlling setting time within 30, 60, 80 and 120 minutes.

The new product is especially adapted to tamping shots in the oilfields of the Illinois Basin, where it makes a material saving of time over the ordinary sand tamp, and for various auxiliary purposes.

Solution of Complete Casing Strings—Walter C. Main, in PETROLEUM WORLD, vol. 37 (1940), No. 9, pp. 27-30.

This paper describes the method of making up a nomographic chart so that complex casing strings may be readily worked out, and also the manner in which this chart can be used.

The graphic charts here presented eliminate the tedious job of calculating the various combinations of weights and grades that go into a string of casing and their use generally leads to the saving of money without sacrifice of safety. The ideas involved in the charts are drawn from many sources, which makes it a cooperative development.

Selecting a Casing and Tubing Program—J. E. Brantly, in PETROLEUM WORLD, vol. 37 (1940), No. 9, pp. 31-32.

The program here offered is based on selecting the minimum diameter of the tube necessary to allow the efficient production of that quantity of oil which the well can or may produce. Emphasis is placed on this matter of the economic and satisfactory minimum. An example is given and discussed.

Concerning the desirability of attaining the practical lower limit to equipment size and weight the author observes that if casing sizes were generally reduced and were internal flush joint drill pipe generally used, the problem of the disposal of old or worn drill pipe in 4½ inch and larger sizes would be solved. It would no longer be necessary to replace or build up tool joints, for the pipe could be run economically as casing and new pipe and tool joints bought for the drilling string. A difficult problem would be largely solved for both the operator and the manufacturer of tubular goods and to the considerable benefit of each. Fishing jobs due to pipe failure should thereby be greatly reduced in number or almost entirely eliminated.

For drilling out and drilling in or deepening strings there is no reason why external upset tubing could not be employed. A special tool joint built for the purpose should be used on each stand. Finally the string could be disposed of by running in the well as production tubing. The tool joint would solve one of the major problems of tubing strings where wells must be pulled at frequent intervals.

The adoption of the principles and practices suggested in the above two paragraphs would eliminate two of the greatest items of cost in the drilling of wells generally; namely, the elimination of the depreciation item on drill pipe itself, though not on tool joints, and the substantial reduction in general drilling costs due to fishing jobs caused by drill pipe failures.

A Practical Survey of Direct Mechanical Rotary Drilling Outfits in California—Victor J. Beissinger, in PETROLEUM WORLD, vol. 37 (1940), No. 8, pp. 31-33; 36; 38; 42; 43a-43b; 45a-45b; 46; 56.

The use of mechanical rigs for rotary drilling (rigs powered by internal combustion engines) has been common with small outfits. Recently there has been a noticeable trend in California toward the use of such outfits in preference to steam as a motive power for "big rigs", which are the ones that are required for deep drilling. The reason for this trend is that the mechanical rigs are lower in first cost, are more easily portable and easier to maintain. This is proven by the successful operation of such rigs under difficult conditions.

The use of the large mechanical rigs is spreading despite arguments put forward by adherents of steam power, who point out the following:

1. Steam power flexibility has not been duplicated.
2. Internal combustion engines must be geared to specific load limits for optimum performance.
3. Power-driven slush pumps are more costly, heavier and subject to gear strength limitations.
4. Reverse gear and clutch mechanisms are subject to frequent adjustment.
5. Rotary machine drive through drawworks countershaft is subject to impact shock which is not conducive to smooth drilling. Rotary clutches suffer the brunt of these impact loads and in the event of failure, would require a shut-down.

In order properly to overcome the criticisms of the direct mechanical rotary outfits the manufacturers have already designed and placed in operation new type clutches, shock absorbing devices, direct application of power to the drum and have utilized the well known speed and torque control characteristics of the hydraulic coupling and torque converter.

Another difficulty has been the necessity of familiarizing drilling crews, habituated to the use of steam power, with the quite different characteristics of the mechanical rigs, but this is a detail. The fuel and water economies, wherever encountered, are said to be generally sufficient for an estimated "pay out" within a one-year period of more or less continuous operation.

OPERATION

Temperature Surveys in Oil Wells—C. V. Millikan, in PETROLEUM TECHNOLOGY, November 1940; Technical Publication No. 1258; 8 pages.

The normal geothermal gradient is considered as being about one degree Fahrenheit for each 60 ft. of depth. This "normal" gradient varies in different areas, but whatever it may be in an area there is little variation from the surface to as deep as the drill penetrates. The normal gradient is appreciably changed by gas expanding from the reservoir into the borehole or by the movement of fluid through a borehole while drilling, producing, or circulating. It is the resulting anomalies and abnormal gradients from which conditions in wells can be interpreted.

After discussing the various types of thermometric outfits for taking well temperatures the author considers a number of examples and their interpretation.

A temperature survey may be helpful in determining stratigraphy, and if properly carried out can locate the depth of certain formations more precisely than can be done from casual samples and driller's logs. Temperature surveys have been used with some success for determining the point to plug back to upper productive horizons. Sands containing salt water show up as obvious anomalies.

A formation may have strata of low permeability, which are difficult to determine from examination of samples. If the formation contains gas under high pressure, the presence and depth of the permeable streaks may be determined from shows in the drilling mud, but the determination may have considerable error. A temperature survey would show the depth of the producing strata and indicate the relative productivity of each.

Gas-producing strata in a sand zone will show a pronounced temperature anamoly. A temperature survey may be used to determine the gas-oil contact, which is important when it is desired to rework a well to shut off gas and set a packer to reduce an excessive gas-oil ratio. A temperature survey can be of material assistance in locating thieving formations into which drilling fluid is being lost. Temperature surveys have also been successfully used to locate the source of incoming water as well as of incoming gas.

A casing leak into or out of the well is one of the most insidious troubles that can develop in a producing well. Such leaks have been located by a temperature survey, and it can also be used to prove the job of repairing the leak has been successful. Since the setting of Portland cement is an eothermic reaction control of well cementing by temperature surveys has been very successful.

The execution of a temperature survey in an oil well requires some skill and knowledge both in preparing the well for the survey and in interpreting the results.

Bottom Water and Oil Production—G. I. McBride, in PETROLEUM ENGINEER, vol. 12 (1940) No. 2, pp. 144, 146-147.

The author expounds the proposition that it is unnecessary to pump bottom water to recover the oil from fields that are under water drive. The essential conditions are that pumping the well must not be at a rate that will raise a water cone through the oil layer, and that the operator must be content with the corresponding slower rate of volume production. Examples are quoted to show that in the long run lifting costs are smaller and ultimate recovery larger. That reduced pumping rates do decrease water pumping has been demonstrated in such fields as East Texas where allowables have been greatly curtailed. In certain favorable cases it offers a number of important economies, such as elimination of sand trouble, salt water electrolysis and corrosion trouble, and removes the necessity for salt-water disposal.

New Type of Secondary Recovery—T. P. Sanders in OIL AND GAS JOURNAL, vol. 39 (1940), No. 32, pp. 39-40.

A new method of producing oil in fields where there has been extensive encroachment of formation water has been adopted in the St. Louis pool (Oklahoma) with surprising and gratifying results.

The innovation came about in this way. A well that was on the beam was pumping 51 bbl. of oil per day with about 500 bbl. of water. The beam outfit was removed and a centrifugal pump was installed in its place. The centrifugal pump increased the production to 365 bbl. of oil with about 2,000 bbl. of water.

On thinking over this phenomenon the following explanation suggested itself: The invasion of the formation water had raised the ground water level so that gas remaining in structural, stratigraphic or porosity traps was under a back pressure that prevented it from forcing additional oil to the low-pressure areas about the well bore. Under the vigorous action of the centrifugal pump the ground water level was lowered; the residual gas expanded and drove the oil into the well.

Acting on this hint, other wells in the vicinity that had also become nearly drowned out were treated similarly, with similar results. This drew attention to locations that had been abandoned. New wells were sunk, and were intentionally drilled deep into portion of the dolomite that had become flooded with water. Old leases that had seemed to reach their end after producing a million bbl. are now considered good for another million.

Some experts have voiced the opinion that this method is justified only under competitive conditions and would show no benefit if the pool were operated by a single company. However, it is not thought that this objection applies to this field as a whole.

Water Cones and Water Sheathes in Experimental Oil Wells—F. B. Plummer and H. K. Livingston, in BULLETIN AMERICAN ASSOCIATION PETROLEUM GEOLOGISTS, vol 24 (1940), No. 12, pp. 2163-2179.

This is a laboratory investigation which has produced some interesting suggestions on the behavior of oil and water in the same well. Oil is, in fact associated with water in most oilfields, and in all water-drive oil reservoirs the oil wells begin to produce water sooner or later.

It might be supposed that where a fine grained, uniform sand is completely penetrated by a well, with the upper half of the sand filled with oil and the lower half filled with water, the well would yield oil and water in about equal proportions. However, it may be found that after the well has been produced rapidly for some time the yield will be more than 90 percent water and less than 10 percent oil. The reason is thought to be that a "water cone" is formed around the periphery of the well; that is, the water rises up through the oil, and tends to shut off the latter. There is also reason for believing that even with slow rates of flow in very fine-grained sand the water tends to be drawn around the periphery of the cone by capillary or wick action, even in shut-down periods. Once a sheath is formed oil tends to be excluded just as in the case of a water cone. The reason for this sheath formation is supposed to be that the interfacial tension between silica and water is different from that between oil and silica.

The authors constructed several experimental wells and verified the conclusion that increased rate of production increases the percentage of water by increasing the height of the water cone and that after the increase has taken place shutting in the well does not reduce the water cone to its original level.

During these experiments it was observed that if instead of producing the sand upward, the direction of withdrawal is downward, the water cone, instead of resembling a funnel with its stem pointing upward, becomes like a funnel with its stem pointing downward. By thus reversing the direction of withdrawal, an experimental well that was yielding two percent of oil and 98 percent of water now yielded two percent of oil and 79 percent of water.

Another suggested way of decreasing water production and increasing oil production is to change the surface tension of the water so that it will less readily climb upward on the sand grains. For this purpose a substance known as Aerosol OT was added to the water in a well that was producing 15 percent oil and 85 percent water. After adding the Aerosol OT the proportions changed to 68.4 percent oil and 31.6 percent water. A solution of Ivory soap had a still more remarkable result, although the permeability of the sand seemed to be reduced.

NATURAL GAS

The Absorber Oil Ouestion; Investigation on the Surface Tension of Benzol-Absorber Oil Mixtures—F. W. Meier-Grolman, W. Oppelt and H. Schmitt, in OEL AND KOHLE, vol. 36 (1940), No. 45, pp. 509-512.

From theoretical considerations the authors were led to expect that the ability of a hydrocarbon oil to absorb the vapors of light hydrocarbon in gases is a function not only of the viscosity of the absorber oil, but also of its surface tension. It seemed reasonable to suppose that of two oils the one with the low surface tension would exert a better washing action, because it will spread out in a thinner film on the Raschig rings or other internal structures of the absorber tower.

They therefore devised a laboratory apparatus for determining the surface tensions of absorber oils and the absorbing efficiencies of these oils were tested. There was found an inverse correlation between surface tension and absorbing (or washing) efficiency. This being the case, it seemed reasonable to suppose that if something is added to an absorber oil to lower its surface tension the treated oil should have a greater washing efficiency than the uhtreated oil. Experiments with additions of small quantities of amyl alcohol, octyl alcohol, or isovalerianic acid verified the supposition,

Liquefaction, Storage and Regasification of Natural Gas—J. A. Clark and R. W. Miller, before NATURAL GAS SECTION, AMERICAN GAS ASSOCIATION, Atlantic City, October, 1940.

The demand for natural gas is largely seasonal; most of it is consumed in the winter when the demand may even exceed the capacity of the gas fields; under such conditions a reserve supply would be very welcome, but storage of natural gas is a somewhat difficult proposition and has never been extensively resorted to except in some cases where it has been found possible to store gas under high pressure in old depleted oil sands.

One result of work done in plants where natural

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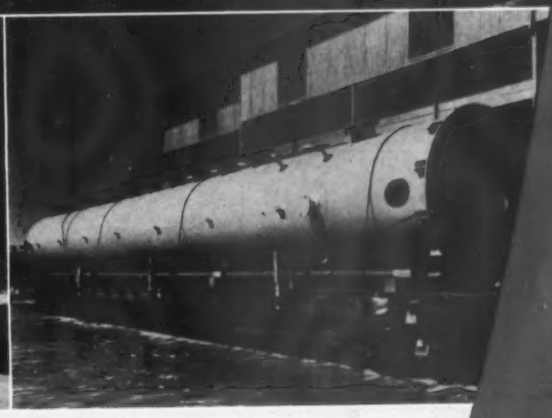

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gas is liquefied for the production of helium has been to show that the liquefaction of natural gas presents no insurmountable difficulties. The main difficulty to be mastered arises from the fact that liquefied natural gas boils at–250 deg. to –258 deg. F., and this involves the use of metal that will not shatter at those temperatures; very efficient insulation against heat would also be required.

To test the possibilities a pilot plant was erected. The method adopted for liquefying the gas is the so-called cascade system of removing heat in steps through the medium of several circuits, each using a different gas which would liquefy at successively lower temperatures and exchange heat. The two gases selected for use in the compression-refrigeration system were ammonia, b.p. –27 deg. F. and ethylene, b.p. –152 deg. F. Very complete removal of moisture and carbon dioxide from the gases to prevent clogging of the apparatus is indispensable; as water-absorbing substances use was made of nonethanolamine and diethylenegylcol. Arrangements are made to bleed out nitrogen, oxygen and other non-condensible gases. For metal that will retain strength at these low temperatures use is made of copper, bronze metal, red brass, stainless steel and steel plate with carbon less than 0.09 percent and nickel over 3½ percent. The best available insulator was found in loose granulated cork filled in between double walled tanks.

From data obtained with this pilot plant there has been designed a plant capable of condensing four million cubic feet a day for supplying the city of Cleveland. There will be three storage tanks with a combined capacity of 150,000,000 cu. ft. The feed gas is taken at 30 lbs. gage and compressed to 600 lbs. gage by a 600 H. P. engine after going through the cooling and liquefying cycle the liquid gas is stored in the well-insulated tanks.

Some Factors Influencing Recovery of Condensate in Recycling Operations—Laurance S. Reid, in PETROLEUM TECHNOLOGY, November, 1940; Technical Publication No. 1259; 9 pages.

The operator of every gas-recycling project is confronted with two problems; (1) to remove a maximum quantity of desirable hydrocarbons from the reservoir fluid and, (2) to return the residue gas to the producing formation at the least possible expenditure for compressor horsepower. While several recycling projects have obtained excellent condensate recoveries while operating at compression ratios that are within the limits of good practice, the continued discovery of gas-condensate production exhibiting pressures ranging from 3000 to 6000 lb. per sq. in. indicates that present-day condensate recovery processes must be improved. Efficient recovery at pressures that would result in minimum compression ratios presents a number of serious problems, which are not yet solved, but indications point to the possibility that both absorption and condensation processes may reach this goal.

It has been found that efficient absorption depends upon the combination of a number of variables such as the composition of the reservoir fluid, the composition of the absorption oil, the oil-circulation rate, and the temperature and pressure of the absorber column. Close control of the physical properties of the absorption oil must be maintained to ensure satisfactory operation, particularly molecular weight and boiling range. In general, the oil used for high-pressure absorption at atmospheric temperatures will differ from that used in conventional low-pressure operation. The A. P. I. gravity and the cold test of this oil should be considerably lower than that of conventional absorber oil, and its initial boiling point should be substantially higher than the end point of the finished overhead product from the still, in order to avoid excessive absorption oil losses. Oil-circulation rates are fairly low, ranging from two to four gal. per thousand standard cubic feet of gas admitted to the absorber when operation is maintained at 1,200 lb. per sq. in. and atmospheric temperature. The oil-circulation rate is very sensitive to changes in composition and temperature of the incoming gas, so that close control of these variables is essential to efficient operation.

A number of obstacles confront the development of the absorption process to operate at pressures up to 3,000 lb. per sq. in.

This matter is further complicated by the fact that commercial operations indicate that any one particular absorption oil will function, satisfactorily, only over a rather limited pressure range. Therefore it seems likely that specially processed absorption oils must be developed to assure satisfactory operation at the desired pressure.

Lately a low-temperature condensation process has shown a substantial improvement in extraction efficiency, but here also certain physical and economic considerations (which the author explains) must be taken into account.

Estimating Availability of Natural Gas Reserves. Paul C. White in REFINER, vol. 12 (1940), No. 3, pp. 23-28.

For obtaining an idea of the useful life of present gas reserves, laying out drilling programs for the immediate future, the probable necessity of purchasing gas to supplement waning supplies, or the necessity of increasing compression facilities to meet system requirements, it is desirable to solve the problem of the future availability of reserves in the formation.

In the past this has been attempted by making a composite curve from the average data of wells producing from the same sand. This method has its defects, which the author proposes to cure by preparing a composite back-pressure curve that will give each well its proper weight based upon its ability to produce. This curve can be constructed from (1) the weighted absolute formation pressure; (2) the total absolute open-flow capacity; (3) the weighted average pressure-flow curve, and (4) the weighted absolute formation abandonment pressure. These four functional values make it possible to forecast the decline of ability of the wells to produce gas during the depletion of the recoverable gas reserves. The method of deriving these functional values and an illustrative example are given.

PIPE LINES

The First Ten Years of Electrical Protection—F. A. Hough, before CALIFORNIA NATURAL GAS ASSOCIATION, Los Angeles, October, 1940.

An account is given of the electrical protection of the pipe lines of the Southern Counties Gas Co. of California. The system comprises some 209 miles of pipe ranging in size from 6 inches to 20 inches laid through a wide variety of local conditions and protected by various electrical systems.

This study relates more particularly to what is known as the General Pipe Line Group having a total surface equivalent to that of 87.4 miles of 12¾ inch O. D. pipe. The total investment in cathodic protection for this group was $9,578.52. The average annual cost (including everything) of protecting this system is about $52 per year per mile of pipe protected.

After setting forth these particulars the author raises the question as to whether the cost of cathodic protection during the past ten years has been justified. An answer is obtained as follows:

Assume that a 12¾ inch line costs, installed, $13,000 a mile and that without cathodic protection or reconditioning it will have a useful life of 25 years. Assume also that it will cost $52 a year to give the line cathodic protection. An actuarial computation then shows that this annual expense will be justified it if only prolongs the life of the line from 25 to 27.75 years, an extension of 2.75 years. This computation neglects entirely the saving in repair costs that would be effected.

Another question comes up for consideration: Should a given line be reconditioned or cathodically protected

Assume that the use of cathodic protection will eliminate any reconditioning or repair costs for at least 15 years, that it costs $5,000/mile to recondition a 12¾ inch line, and that the reconditioning job will have a life of 15 years. The cost of this reconditioning distributed over the life of the job is

Interest (6.7% of $5,000)	= $330
Depreciation (15-yr. life 5% sinking fund)	= 232
	$562/year/mile

The amount by which this figure exceeds the total annual cost/mile of applying cathodic protection to the line in question represents the saving resulting from the use of cathodic protection.

A comparison of this figure with the average cost of cathodically protecting 12¾ in. O.D. pipe, which in our case is approximately $52/year, indicates that under the conditions cited, a saving of approximately $510/year/mile of pipe can be effected by cathodically protecting in preference to reconditioning, and that therefore under such conditions the reconditioning of a pipe line cannot be justified.

Experiences in the Cathodic Protection of Submarine Pipelines—Gordon N. Scott, in OIL WORLD, Vol. 39 (1940), No. 20, pp. 37-42.

Pipelines laid in salt water are usually heavy, with wall thicknesses of up to ½-inch in order to have enough metal to last 8 to 12 years in this corrosive medium. In other words more steel has to be used than would be required to meet the purely mechanical requirements. Obviously, if the pipe could be given adequate cathodic protection at a reasonable cost the initial expense of the line might be appreciably reduced.

The author gives the case histories of five submarine pipelines on the Pacific Coast that were cathodically protected. These cases have all been successful and the cost of power is nearly negligible. There is some indication that coating the pipe might be of advantage but it is a question of figuring the cost of coating and the cost of power in each separate case.

Soil Resistance Data Aid Electrolysis Studies—W. G. Wilson, in OIL WEEKLY, vol. 100, No. 2, pp. 40, 42, 44, 46, 48, 50.

In the investigation of soil conditions in relation to buried pipe lines the author uses an equipment consisting of an ohmmeter, two soil rods and two connecting wires. In practice the rods are inserted at suitable distances apart in the soil to be tested

and an electrical circuit is closed through the ohms meter and its battery. Whereupon, with the aid of a Wheatstone bridge, the electrical resistance of the soil is measured. Low resistance indicated good soil conductivity and hence the presence of soluble electrolytes that are capable of a corroding action on the pipe metal; high resistance indicates a lesser degree of corrosivity of the soil.

The advantages of the method are that soil conditions are conveniently measurable in short sections and at different depths by six-inch or one foot increments. Alternative routes for the line may be rapidly surveyed. The method is particularly adapted to reveal the presence of a very thin stratum of high corrosivity that might be overlooked by other tests. It need not be confined to exploration for new lines but is applicable to electrolysis surveys on existing lines in conjunction with line current surveys. It would seem that the use of the method is especially indicated in prospecting for good ground bed locations. Naturally, moisture conditions will be duly noted and allowed for.

REFINING

Economic Factors in Catalytic Cracking—J. S. Carey and H. W. Ortendahl, before WESTERN PETROLEUM REFINERS ASSOCIATION, October, 1940.

The chief influences affecting the economics of catalytic cracking are catalyst activity and the space rate or rate of throughput. The most "active" catalysts are not necessarily the most economic; for instance, a catalyst might produce a yield of 65 percent of gasoline and still be of little value because of difficult regeneration and high production of carbon and gas. What the practical refiner requires is a catalyst that will give the "optimum result", which will be a combination of large liquid recovery and ease of regeneration. The next prime factor is the space rate, or throughput on a once-through basis according to prevailing conditions. Various Houdry units are operating at space rates as low as 0.75 and as high as 1.90, with gasoline yields from 38 to as high as 50 percent on the low rate plant.

Operating costs of Houdry plants of various capacities are given as follows:

Operating labor: For a plant of the catalyst volume chosen and charging capacities the following operating labor requirements are representative: Turbo operator, 1 per shift; stillmen, 1 per shift; case operators, 1 per shift; case operator helpers, 1 per shift; firemen, 1 per shift. Personnel capable of handling thermal cracking equipment have in all cases been able to take over catalytic-plant operations after very short supervisory periods.

Utilities:				
Space rate	**0.75**	**1.00**	**1.25**	**1.50**
Case charge, b.p.d.	**8,075**	**10,750**	**13,400**	**16,100**
Cooling water, g.p.m.	**4,100**	**5,100**	**6,000**	**6,800**
Treated boiler feed water g.p.m.	**145**	**145**	**145**	**145**
Steam, net make, lb./hr.	**19,400**	**15,260**	**11,120**	**7,100**
Power, net required, k. w.	**55**	**70**	**85**	**100**
Fuel, B.t.u./hr. fired	**.53x10⁸**	**70x10⁶**	**88x10⁶**	**106x10⁶**

Catalyst cost ..... **$110 per calendar year**

Maintenance (including cleanouts) 4-4.5 per cent of investment per year.

Royalty: $150 per calendar day barrel of case charge.

In view of the necessity of augmenting national defense it is of interest to note that the process is outstanding for the production of a base aviation fuel. One refinery has been producing such fuel as a commercial product for over 3 years and it seems well established that this product is unique in that it is paraffinic in nature and yet has the required antiknock characteristics, and requires a blend of about 35 percent alkylate with 3 cc. of lead to produce a 100 Army octane gasoline. The use of such base stock will therefore in effect, make available a greater quantity of 100-octane fuel as compared with a straightrun base which requires a greater percentage blend of alkylate.

Obtaining Aviation Gasoline by Alkylation and Polymerization of Cracking Cases in Liquid Phase—Alfredo Pinilla, in BOLETIN INFORMACIONES PETROLERAS, Vol. 17 (1940), No. 189, pp. 5-19.

This is a report of an orienting research to determine optimum conditions for making a 257 deg. F. end-point aviation fuel base from refinery cracked gas by the cold sulphuric acid process. These conditions (batch operation) were found to be as follows:

(a) Molar ratio of sulphuric acid: butylenes, 4 to 5.5.

(b) Concentration of sulphuric acid, 95 to 98 percent.

(c) Temperature of reaction, 20 deg. to 30 deg. C.

(d) Time of reaction, 15 to 30 minutes.

(4) Molar ratio of isobutane; butylene, greater than 1.

The yield of 257 deg. F. end-point gasoline under these conditions is about 21 percent on the volume of the liquefied gases. The octane numbers in the clear were mostly around 87 and 88. When the molar ratio isobutane: butylene was less than 1 some of the butylene was polymerized, resulting in a diminished lead susceptibility of the product.

Hydrogen Sulphide (H_2S) Removal—Henry N. La Croix, in WORLD PETROLEUM, Annual Refinery Issue, 1940, pp. 80-81.

A description, with flow-sheet, is given of an installation for removal of hydrogen sulphide from gas by the Shell Phosphate Process which employs a water solution of tri-potassium phosphate as the wash liquid. The solution is regenerated with steam and the H_2S is disposed of by burning in the boiler furnaces or otherwise. This process is now being used on charge stocks for producing various high octane fuels; in some of these units it is employed for treating both gases and liquids, and by a manufacturer of isopropyl alcohol.

Solutizer Process for Sweetening Gasolines—L. E. Border in OIL & GAS JOURNAL, Vol. 39 (1940), No. 10, pp. 36-38, 40.

Particulars are given of a patented process which in principle consists in the addition of an organic solvent or salt to an aqueous alkaline solution (caustic) used to wash sour gasolines. The addition agent that comes mostly into questions is potassium isobutyrate, and a typical "solutizer" solution for sweetening 400 deg. F. end-point straightrun west Texas gasoline has the following composition:

	Normalities	
	Original	After 3 months service
Potassium hydroxide (KOH)	**6.00**	**6.02**
Potassium isobutyrate (KIB)	**3.00**	**2.94**
Potassium carbonate (K_2CO_3)	**0.40**	**0.41**
Potassium mercaptide (KSR)	....	**0.006**
Potassium sulfide (K_2S)	....	**0.001**

The use of this solution is based on the fact that the mercaptans which give raw gasoline its most disagreeable characters are insoluble in water and hence are not removed when the gasoline is given an ordinary caustic wash or Doctor treatment. Addition of potassium isobutyrate greatly increases the water solubility of mercaptans and hence makes it possible to remove them effectively and economically.

The above applies to gasolines that are free from phenolic material; for gasolines containing alkyl phenols some potassium alkyl phenolate is also added.

Besides a quite satisfactory and economic removal of sulphur compounds, it is found that solutizer-sweetened gasolines have in general higher octane numbers and a greater lead susceptibility; contrary to what occurs in the classic Doctor process, this sweetening treatment involves no loss of valuable components.

Improving Lead Susceptibility with the Shell Solutizer Process—H. N. La Croix, before AMERICAN SOCIETY MECHANICAL ENGINEERS, Petroleum Division, New York, January, 1941.

The chemistry of the removal of mercaptan sulphur from gasoline is reviewed, with particular reference to the solutizer process. This process depends primarily on the addition of a substance (potassium isobutyrate) to a caustic wash liquid; the added salt has the effect of transforming the higher mercaptans from an insoluble to a water-soluble condition and thus makes them open to attack by the caustic.

The solutizer process applied to sulphur-containing gasolines accomplishes a dual purpose. In the classic caustic sweetening process the mercaptan sulphur was merely changed to another form and left in the gasoline. Thereby the bad odor of the product was suppressed, but the sulphur still remained as more or less an obstacle to a quality improvement through the use of tetraethyl lead. By "solutizing" the mercaptan sulphur is taken out and the use of tetraethyl lead is then more effective in raising the octane number. The degree of improvement in octane number is high enough to make the process commercially attractive.

Centrifugal Separation of Doctor-Blackstrap Emulsions—Harold Bottomley, in REFINER, vol. 20 (1941) No. 3, pp. 50-52.

Blackstrap-emulsions, consisting of a mixture of lead sulphide, spent plumbite and oil are often a nuisance in the process of doctor-treating gasolines. The difficulty of breaking these emulsions, the loss of oil and contamination of lead sulphide constitute one of the economic arguments against the doctor treatment.

The author describes a centrifugal machine which satisfactorily handles this unwelcome by-product. The machine takes the emulsion and separates it into its three components — spent doctor solution, solid lead sulphide, and oil. Gasoline of any desired clarity is taken off at the top; from an intermediate point clean spent doctor solution is sent back to the regenerators, and the lead sulphide drops from a lower discharge.

The machine and accessories as installed at the Big Springs (Tex.) refinery of the Cosden Petroleum Company has been continuously operated for three years without operating difficulties. The bowl of the machine, which is of the separator type, is driven by a 15 H. P. motor at 5,400 to 5,600 r.p.m. With a very tight emulsion its output is 25 bbl. an hour, but under more normal conditions it will easily handle 40 to 45 bbls. per hour.

Emulsion from treating 1,000 bbls. of gasoline

at this refinery amounts to about 20 bbls. which contains about 50 percent gasoline, 25 percent spent doctor solution and 25 percent by volume of solid lead sulphide. The gasoline is practically 100 percent recoverable. Putting the cost of the outfit at $5,000 and figuring in various items of saving as compared with the old method of handling these emulsions, and also the cost of power, maintenance, depreciation and interest, it is found that the installation paid out in 63.15 days.

Sweating of Oil-Free Waxes—M. F. Sawyer, T. G. Hunter and A. W. Nash, in JOURNAL INSTITUTE PETROLEUM, vol. 27 (1941), No. 207, pp. 1-14.

The authors devised an apparatus for studying the fractional melting separation of waxes of different melting points from an oil-free wax stock. The apparatus consists of a basket with interior and exterior electric heating elements by which the wax can be melted at pre-determined rates. It is proposed to use this apparatus to construct diagrams that may be used as a basis for computing sweating efficiencies.

The principal point revealed in the experiments is that melting of the wax mass at a rate of 3 percent or less per hour is the most satisfactory procedure; that is, the rate best calculated to separate waxes of progressively higher melting points. Preparation of samples by shock cooling to room temperature results in a wax mass that is more difficult to sweat in the early stages of the process. It will be better to cool the material to a temperature slightly below the solidification temperature instead of to room temperature. Local overheating even to the extent of 2 to 3 deg. F. has an adverse effect on the yields of the waxes.

CHEMISTRY

Hydrogenation of Petroleum Fractions with a Large Amount of Catalyst—H. I. Waterman and C. van Vlodrop in JOURNAL INSTITUTE PETROLEUM, vol. 26 (1940) No. 203, pp. 452-456.

In the examination of hydrocarbon mixtures it is frequently necessary to saturate these mixtures completely by hydrogenation. If the hydrogenation is effected with a nickel catalyst, it is in many cases necessary with technical oil fractions to repeat the hydrogenation treatment many times, employing a fresh quantity of catalyst for each treatment. The authors have now succeeded in accelerating considerably the catalytic hydrogenation under high pressure by using a very large quantity of catalyst (100 per cent. and more). The oil fractions examined showed no decomposition nor objectionable changes in structure. They thus succeded in converting dark and even asphaltic oil fractions or residues into completely colorless saturated products by subjecting them a certain number of times to hydrogenation by the new method.

Extraction of Metallic Constituents from Oil—E. P. Rittershausen and R. J. De Gray, before Division of Petroleum Chemistry, AMERICAN CHEMICAL SOCIETY, St. Louis meeting, April, 1941.

This method describes the use of tetraethyllead extraction apparatus for the quantitative extraction of the metallic constituents of new and used motor oils, extreme pressure lubricants, greases, paints, and paint driers. The sample is dissolved in a suitable organic solvent which is immiscible in water. The metals are extracted into the aqueous layer by refluxing the mixture for the necessary length of time. The aqueous layer is drawn off and analyzed for the metals it contains. This procedure eliminates the difficulties encountered in destroying the organic matter, and the errors involved in ashing compounds having volatile metallic oxides. No metals have been encountered which could not be handled by this method.

Catalytic Oxidation of Aliphatic Kerosene Fraction—W. George Parks and E. Francis Story in OIL & GAS JOURNAL, Vol. 39 (1940), No. 17, pp. 54-56, 58, 60.

Laboratory experiments showed that a C_{12} to C_4 fraction from kerosene could be converted into a mixture of the corresponding aldehydes and organic acids by vapor-phase oxidation in the presence of a catalyst, preferably nitric acid yields per pass amounted to approximately 20 percent of aldehydes and 5 to 1.5 percent of acids; the optimum temperature found in the experiments was 300 deg. to 330 deg. C.

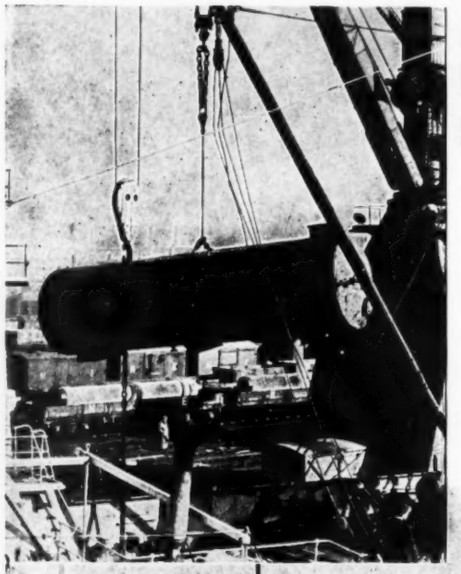
The aldehydes and acids produced are not identified as chemical individuals, but it is indicated that they might be made the bases, as raw materials, of possible commercial exploitation.

Determination of Gum-Forming Substances in Motor Fuels—Paul Nashan, in OEL UND KOHLE, Vol. 36 (1940), No. 37, pp. 349-350.

This contribution relates to a more efficient and time-saving way to determine the aging quality or oxidizability of a gasoline. The determination is executed with the aid of the apparatus illustrated in the accompanying sketch.

The small flask *a* carries a condenser *b*; the hollow end of the condenser is provided with a spraying arrangement *c*, which has 4 to 6 small tubes *d* open at the bottom and projecting a small distance into *c*; at the extreme lower end of the condenser's inner tube, and close to the bottom of the flask, is the reflux opening *e* which is provided with numerous small holes.

In operation the flask is supplied with 100 cc.



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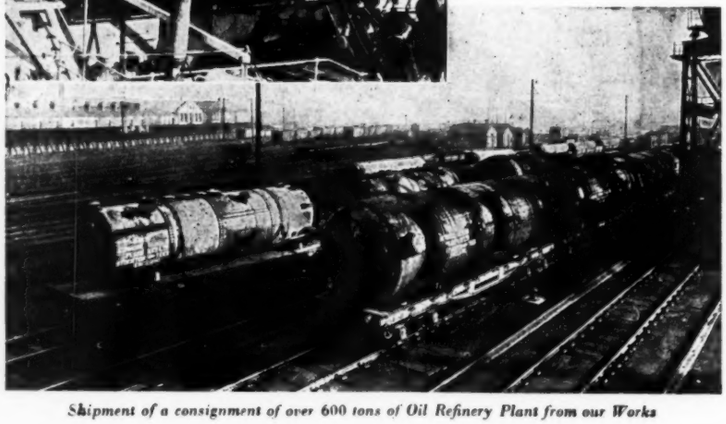

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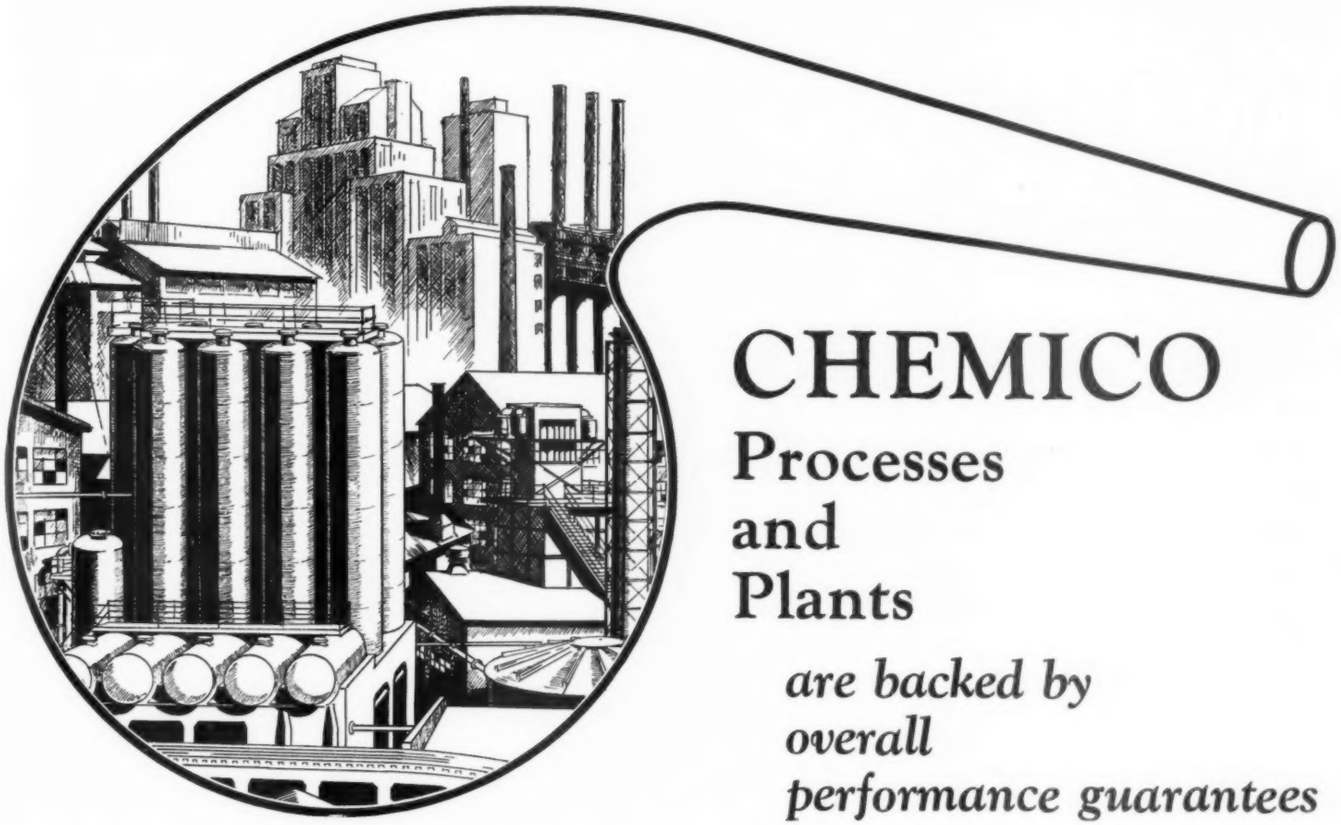

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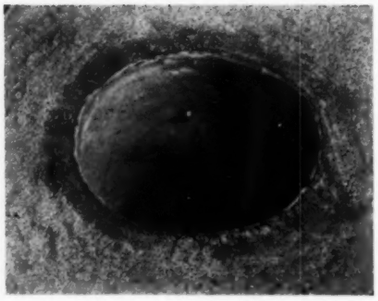
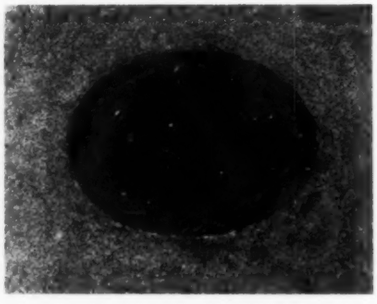
- LOW WATER LOSS TO FORMATION
- LESS SWABBING
- WELLS CLEAN UP MORE QUICKLY
- WELLS HAVE HIGHER POTENTIALS
- MORE ECONOMICAL



Photograph of cross-section of 8⅝" hole in which straight AQUAGEL-water mud was used, showing thin mud cake and slight infiltration of water in area surrounding hole.



Photograph of cross-section of 8⅝" hole in which native mud has been used. Thick mud cake has reduced hole diameter to 6⅝". Water has permeated far into formation surrounding hole.

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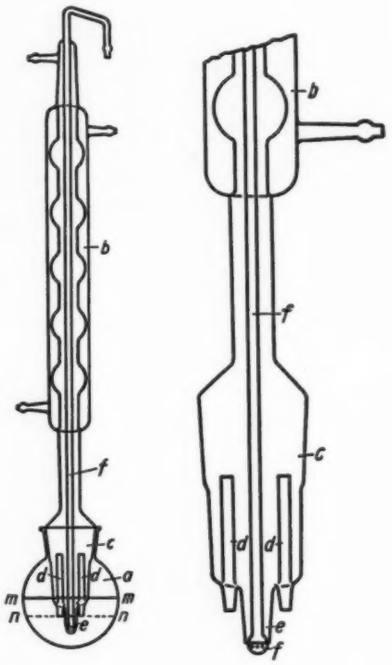
of motor fuel to fill it to about the level m-m. The condenser is seated in the ground glass joint and the upper end of the condenser tube is connected through a meter and bubble counter with a source of oxygen gas. The flask is heated to boiling with a small burner, and the current of oxygen gas is started. Pressure accumulates in the closed space above m-m and forces the liquid level down to n-n where the pressure is released by escape of gas, liquid and vapor through the small tubes *d*. Gas, vapor and liquid stream into *c* and up the condenser tube, and thorough mixing results; condensate flows back to reestablish the level m-m and the process repeats.



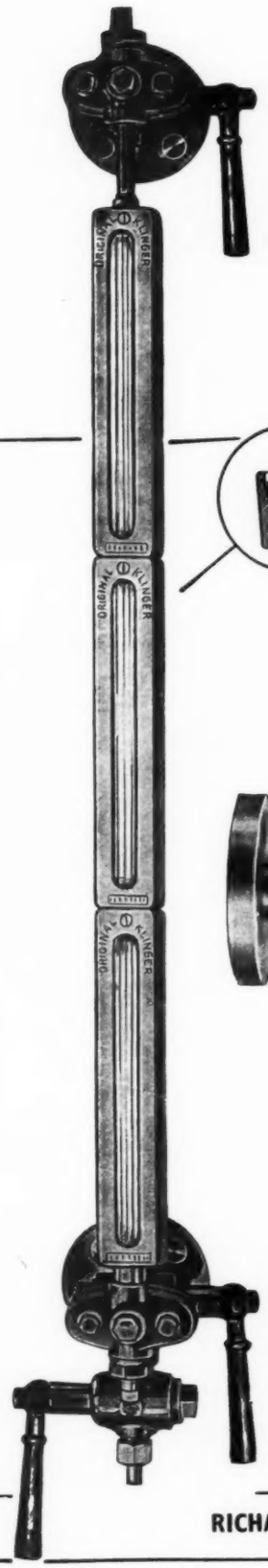
As a result of this thorough mixing of liquid and gas the time required for converting oxidizable materials into gum substance is reduced from 3 hours (in the old methods) to half an hour, and the amount of oxygen needed is reduced by half. The test is concluded in the usual manner by distilling off most of the liquid and separating the gum in the residue with methyl alcohol and pure benzol. The results of the more rapid new method check very well with the older, longer ones.

PHYSICS

Experiments on Flow of Heterogeneous Fluids Through Consolidated Sand—John A. Putnam, before AMERICAN INSTITUTE MINING & METALLURGICAL ENGINEERS, Los Angeles, October, 1940.

The experimental method of attack described here is a practical approach to the general problem of flow of heterogeneous, hydrocarbon fluids through natural consolidated sands. The portion dealing with the flow of saturated liquids suggests a possible means of measuring the viscosity of such liquids at elevated pressures.

In the work on heterogeneous, gas-liquid mixtures, it was found that the total flux varied linearly with the pressure gradient, and that when



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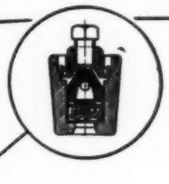

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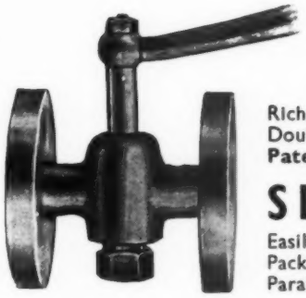

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April 29, 1940

THE ATLANTIC REFINING COMPANY

PHILADELPHIA, U. S. A.

the specific permeability of the sand was less than approximately 1.36 darcys, the system could support a finite pressure gradient without flow. This critical gradient—called threshold gradient—was found to depend upon the ratio of free gas to saturated liquid in the sand and upon the specific permeability of the sand. A pseudo viscosity was defined by dividing the specific permeability of the sand by the slope of the total flux-pressure gradient curve. This pseudo viscosity depends only on the total gas-oil ratio.

In comparing the results of these experiments with the work of Wyckoff and Botset, it was found that the effect of dispersed gas bubbles in the porous medium was taken into account on the one hand by an increase in the apparent viscosity of the fluid mixture and the introduction of a threshold gradient; while on the other hand, this effect accounted for a decrease in the relative permeabilities of the gas and liquid phases. Both investigations indicate the existence of a critical permeability above which the specific permeability no longer affects the flow behavior.

Effect of Variations in Atmospheric Conditions on Diesel Engine Performance—Jesse S. Doolittle before Oil and Gas Power Division, AMERICAN SOCIETY MECHANICAL ENGINEERS, Asbury Park, June, 1940.

This paper presents the variations obtained in fuel rates and maximum power output of a two-cycle Diesel engine when there were changes in the temperature, pressure, and humidity of the supply air and in the exhaust pressure. The author found the engine to be quite insensitive to any of these changes at light loads. At loads in excess of the load of minimum fuel rate, any changes in intake or exhaust conditions that affected the air supply to the engine measurably changed the fuel rate and maximum power output.

Saybolt One Fifteen Viscosimeter—E. L. Dean, E. L. Ruh and R. W. Walker in INDUSTRIAL ENGINEERING CHEMISTRY, Analytical Edition, Vol. 12 (1940), No. 9, pp. 540-542.

Modern developments in the production and utilization of lubricating oils have created a need for a higher degree of precision in the determination of viscosity than can be attained with the Saybolt Universal viscosimeter. The A. S. T. M. has standardized apparatus and procedure for the convenient and accurate determination of kinematic viscosity (*3*) and has established official tables (*1*) for the conversion of these values to the familiar Saybolt Universal scale. These developments, however, do not fully meet the needs of certain laboratories where conditions are not favorable for the use of long-capillary glass instruments.

There are actually two forms of the Saybolt instrument, the Fural and the Universal types which are identical except as regards the diameters of the outlet tubes, so that the outflow of the former is about one-tenth that of the latter. The new Saybolt one fifteen viscosimeter is identical with the Universal except that it has an orifice diameter of 1.15 millimeters and a theoretical efflux time ratio of 5.5 as compared with the Universal. The name "Saybolt One Fifteen" is derived from the diameter (1.15 m.m.) of the outlet.

The object of constructing such a viscosimeter is to obtain a longer efflux time, thus improving the accuracy of the determinations in the low range and reducing the ratio between differences

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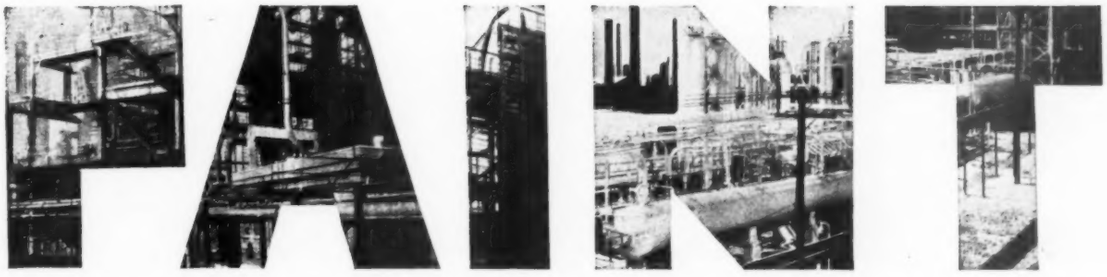

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in terms of the Saybolt outflow time and kinematic viscosity. A number of these instruments have been constructed and have been in satisfactory use in various oil laboratories for longer than a year. One necessary precaution in their use is to avoid excessive dust in the room where tests are being made, otherwise particles that become lodged in the outlet tube may cause discordances.

Analysis of Some Illinois Crude Oils—Harold M. Smith in BUREAU OF MINES, Report of Investigations, No. 3532 (1940).

Analyses of 35 samples of petroleum from new and seven from old Illinois fields are reported. The characteristics of the samples are discussed briefly. The oils are on the whole similar, especially as regards distillation and gravity characteristics. No low-sulfur oils were found in the group of fields along the eastern Illinois border. In refining the oils behave like Mid-Continent crude oils of similar gravity. No unusual difficulties are found with the possible exception of sulfur in the heavy naphtha distillates from Devonian production.

Engine Design vs. Engine Lubrication—R. J. S. Pigott, before SOCIETY AUTOMOTIVE ENGINEERS, Detroit, January, 1941.

It is pointed out that the present trend in automotive engine design toward higher compression ratios, more power per cubic inch and higher speeds of revolution, have involved the lubricating oil manufacturers in troubles that they have difficulty in meeting. Engine oils are subjected to operating conditions that increase their temperature and consequently their deterioration, which cannot be circumvented by inhibitors.

The author discusses various cases that came up in his experience as a lubrication engineer. In these cases it could be demonstrated that oil deterioration and bearing failure was due not to the lubricating oil but to faulty engine design; the troubles disappeared after a few mechanical changes that the car manufacturer should have attended to before he put his car on the market. Detection of such defects need be no more than routine testing. It is possible that, given time enough, the oil chemist may develop a compound, doped or special oil that will more or less compensate for a bad design, but in the car manufacturer's own interest he should beware leaning too much on the chemist; in seeking economy he should make sure that he is not acquiring troubles that will pile up before the chemist can save him.

Wider Well Spacing — Panacea or Delusion—S. K. Clark, in OIL WEEKLY, vol. 100, No. 2, pp. 14-17.

It is maintained that the persistent decline of per-well allowables under proration is due to excessive rate of over-development, and that well spacing, whether on 10, 20 or 40-acre tracts has nothing to do with it. Hence, advocates of wider well spacing as a solution for the problem, of declining allowables are following an aberrant trail. The fact is that the overall or general rate of drilling is stimulated by the use of wider spacing, instead of being reduced.

The indicated remedy is a reduction in the general drilling rate rather than a decrease in well density. It appears that the logical way to attain the object desired would be to graduate allowable on a basis of the age of the field so as to place the restraint where it is most needed—on unnecessary new development.

For instance, allowables might be graduated on the basis of the age of the fields. Thus all fields over five years old might be given the top allowable, those four years old scaled down by 5 percent, and so on, so that wells in a field less than year old would only be entitled to 75 percent of the top allowable.

Among the indicated advantages of the plan are that it would reward reasonable rates of development and penalize excessive ones. It would encourage the continuance of development until a field was fully exploited, in contrast to the economically absurd situations now existing in many fields more than five years old, where a reasonable rate of further development cannot be financed out of the field revenue, due to gobbling of the available market due to excessive drilling in other areas. It would put well spacing back where it belongs, as a question to be decided on its merits rather than a panacea for the ills of the industry.

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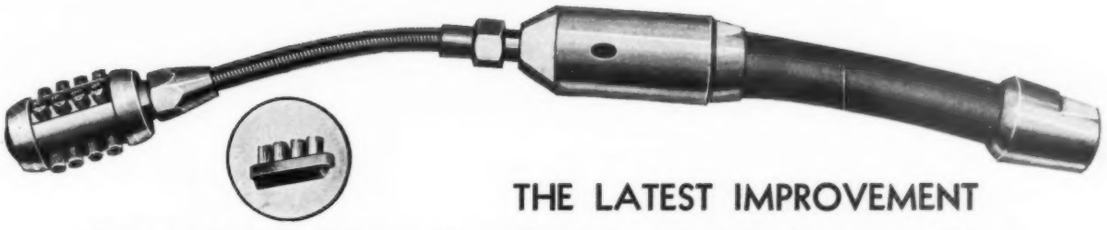
For maximum efficiency, all tubes should be thoroughly cleaned. In one actual case, thorough cleaning of heat exchanger tubes provided an increase of 20%, in heat transfer and 10% increased throughput. Shown on this page are a variety of small tube cleaners made by Airetool. Those at the left are particularly effective in tubes of very short radius bends. Cutter heads, expanding blade heads, drill heads and brushes are available for all size tubes.



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Shown above is an Airetool Cleaner with expanding brush type head. The brush segment (shown in the circle) is a new Airetool development. Wire tufts are set in a solid base and held in place with a lock pin. The back of the brush is solid . . . tufts cannot be pushed out as they could in other type brushes. This means fewer replacements.

The Airetool Cleaner and Motor shown above is a light, geared air or steam driven cleaner for heavily scaled heat exchanger, condenser or other small tubes. The powerful cleaners at the left are for straight tubes ½" I.D. to 1½" I. D.

Whatever your tube cleaning problem, Airetool has an efficient cleaner for the job. Sizes, ½" to 20" I.D. Airetool also makes Tube Expanders, Tube Jigs, Flycutters, Cut-Off Tools, Safe Catalyst Cleaning System; Calipers, Tube Gauges, Tool Trucks and other refinery specialties. Write for information.

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A Book of Valves

(Continued From Page 31)

dustry). They are, in a manner of speaking, the indispensable traffic police in all processes and operations where liquids, vapors, or gases have to be moved in regular order from one place to another. They are called on to regulate the passage of hot or cold materials under high or low pressure, at fast or slow rates as required, without loss and without accident. To enable them to perform these functions there must be build into them the qualities appropriate to the service.

The forging hammer is not unknown in the shops of other companies; in the Vogt works its use seems to have been developed into a consumate art. Forged material is unequalled for the requirements of modern industry, especially for the exacting function of valves. Forging kneads metal into a dense mass, refines the grain, eliminates porosity and confers on the piece a uniform structure and accurate dimensions. These qualities are not possessed by the billets as they come from the rolling mill; it is the terrific pressure of the forging hammer which beats toughness into the material from which valves are made. The forging hammers in the Vogt shops range from 1,000 to 25,000 pounds in dropping weight, and turn out forgings weighing a few ounces up to more than 2,000 pounds. This shop is said to contain the largest drop forging hammer used in the production of valves, flanges and fittings in the world; on a single stroke it exerts over a half-million foot-pounds of energy and creates pressures as high as 12,000 tons to the square inch.

It takes more than a forge hammer to make a valve. Other equipment comes into play: patterns, moulds, master dies, heat treating furnaces, pickling baths, shot and sand blasts for cleaning. The hammer man has mostly to execute the designs of die sinkers who spend most of a life time in acquiring a marvelous skill. After the hammer and the working die come a series of physical and chemical processes in which the valves and their parts are normalized, nitrided, passivated, machined, painted and otherwise treated to confer durability and serviceability in any general or special service that may be required of them. Not the least important of this routine is the inspection that is made after each machining operation, by inspectors who are independent of the fabrication chiefs and who throw out faulty work without fear or favor.

Valves that come through this gauntlet are no doubt as perfect as skill and a feeling of responsibility can make them. Vogt's catalog offers them in all models and sizes, fabricated from materials having the chemical compositions required for different services, for corrosive and non- corrosive conditions, for low and for high pressures, for high and low temperatures. The user can here satisfy himself with any A. S. T. M. specification: carbon steel in all tensile strength classes; carbon-molybdenum; all the chromes; chromium plus molybdenum; chromium plus nickel; and valves, flanges and fittings entirely or in part of stainless steel.

In thumbing through this sixtieth anniversary catalog one soon realizes that the valve business has to provide for an immense number of requirements; it seems that a valve manufacturer must be in the business a long time simply to learn what is needed as well as how to make it. A huge amount of working capital must be tied up in an inventory from which any demand can be met at any time from a stock of standard forms and sizes. Beyond that, the Vogt engineers announce their willingness to concretize any design that inventors or innovating engineers may present to them.

Generalized Cross Section Through the Central Appalachian Geosyncline, by Robert C. Lafferty, Charleston, W. Va. Published by the author, $5.

This is a large chart, 25″ x 37″ in colored lithoprint showing two cross-sections, one from near the intersection of the O., Ind. and Mich. State lines some 360 miles to near Elkins, W. Va.; the other from near Frankfort, Ky., to near Pittsburgh, Pa.

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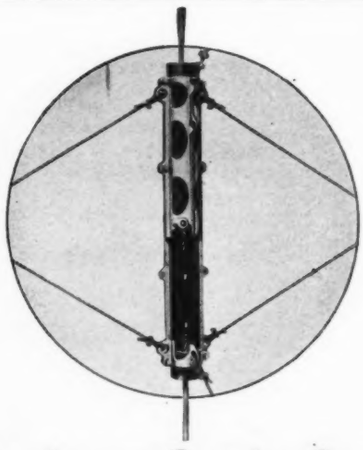

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